(12) LEVEL II

NAMRL-1279

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: ADVANCED SQUADRON VT86-AJN (NEW SYLLABUS)

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June 1981

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
PENSACOLA, FLORIDA

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Naval Medical Research and Development Command
MF58.524.005-7032

25 June 1981

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SUMMARY PAGE

THE PROBLEM

Airsickness in Naval Flight Officer (nonpilot) training squadrons can be considered to be a significant biomedical risk having both direct and indirect influence on the cost of training aircrew personnel. During flight, airsickness can degrade student performance and sometimes necessitate repeat hops to achieve training objectives. Additional dollar costs also result when students attrite because of airsickness, with these costs rising rapidly when the attritions occur late in the training program or even later in fleet assignments. Currently, there are few operational data available to describe either the actual incidence or resulting costs of the airsickness risk in these squadrons, and hence, there is insufficient information available for flight surgeons and medical boards to make decisions concerning disposition of airsick individuals. In addition, validated biomedical tests of motion sickness susceptibility to screen and select aircrew candidates best suited for fleet assignments involving different degrees of motion stress are not yet available.

FINDINGS

A longitudinal study has been initiated of airsickness problems in the primary, secondary, and type-specific fleet readiness (RAG) squadrons comprising the complete Naval Flight Officer (NFO) Training Program. Flight data, based upon both instructor and student judgments of airsickness severity, are being collected in the primary and secondary squadrons on an individual-student basis. In addition, a large segment of the sample population has been exposed to several prototype laboratory tests of motion sensitivity which will be related to the subsequent flight data. The data will define the incidence and severity of airsickness in the individual squadrons, and also serve as operations-based validation criteria for establishing the relative merit of the different components of the laboratory test battery.

This report deals with airsickness incidence in the current flight syllabus of Advanced Squadron VT86-AJN where NFO students are trained to perform various weapons operation and navigation duties. A previous report described the airsickness problem for the same squadron flying a different syllabus which was changed to its present form in 1979. Flight data collected from 1,552 hops flown by 92 students in the new syllabus indicate that airsickness occurred on approximately 13 percent of the total hops flown, vomiting occurred on 4.6 percent of the total, and performance degradation caused by airsickness occurred on 5.5 percent of the total. Approximately 71 percent of students reported being airsick on at least one flight, 36 percent reported vomiting on one or more flights, and 41 percent considered their inflight performance to have been degraded by airsickness on one or more hops. These figures indicate a slightly higher incidence of airsickness in the current, as compared to the previous, flight syllabus of this squadron. As with the previous reports of the series, the results of several brief motion reactivity tests to which a large segment of the population was exposed

are presented and various comparisons made between different student subpopulations based upon the flight and laboratory test data.

ACKNOWLEDGMENTS

The project investigators wish to thank Mr. Andrew N. Dennis, Jr., Bioengineering Sciences Division; Mr. Joel W. Norman, Vestibular Sciences Division; and Mrs. Jack A. Martin, Sensory Sciences Department, for their continued contributions to the conduct and documentation of the study. Acknowledgment is again made to Commander W. R. Logue, USN, Commanding Officer, VT-86; Lieutenant Commander W. J. Mayhew, USN, VT-86; Lieutenant C. W. Peters, USN, VT-86; and Petty Officer First Class E. Bishop, USN, VT-86, for their cooperation during this phase of the study. In addition, especial appreciation is extended to the many students and their instructors who conscientiously provided the airsickness data throughout the course of flight training in VT-86.

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INTRODUCTION

This is the fifth in a series of research reports dealing with a longitudinal study of airsickness in Naval Flight Officer (NFO) students being trained for a variety of nonaviator flight assignments in fleet squadrons. The study, described in detail in the first report (3) of the series, was designed to investigate the incidence and severity of airsickness experienced by a sample of the NFO population on an individual-student basis as they progress through the basic (primary level), advanced (secondary level), and fleet readiness (commonly referred to as RAG) squadrons comprising the NFO training syllabus. The study also relates the airsickness data collected in the flight environment to the performance of the students on several motion reactivity tests which were presented to a large segment of the total sample population prior to their beginning flight training. The long-term objective here is to utilize the inflight airsickness data as validation criteria to measure the relative effectiveness of the motion reactivity tests in identifying, on an a priori basis, both those students who are highly susceptible to airsickness and those students who rarely experience the problem. The inflight airsickness data thus serve this test validation function as well as defining the magnitude of the airsickness problem within each training squadron.

In the second report of the series (4), airsickness data were presented for 134 NFO students receiving advanced/secondary training in Squadron VT86-AJN. That student group flew a total of 1,833 documented hops in a flight syllabus composed of 14 separately identified hops. Midway in the study, the Squadron VT86-AJN flight syllabus was restructured and expanded to 18 hops. This report deals with the airsickness reported by a second NFO student population (92 students) receiving flight training in the same squadron but under the new (current) flight syllabus conditions. The statistical tests used to analyze the airsickness data are, in general, identical to those used in the first report. The intent of these tests is to give preliminary insight into the relative strength of different flight and laboratory response measures in identifying differences that may exist between different student subpopulations. To facilitate reader comparison of the results associated with the new and old flight syllabi, the layout of the associated statistical tables and figures presented in this report closely duplicates the tables and figures of the first VT86-AJN report (4). The reader is referred also to the initial report (3) of the series for many of the procedural and analytical details not presented in this follow-up report.

PROCEDURE

A block diagram of the different training pipelines currently followed by NFO students before assignment to the fleet squadrons is presented in Figure 1. This report deals with the airsickness problem in Squadron VT86-AJN where NFO students receive advanced/secondary flight training in preparation for a variety of nonpilot duties performed aboard attack and antisubmarine warfare aircraft. In this squadron, students are trained in both TA-4J and T-39D aircraft (photographs of

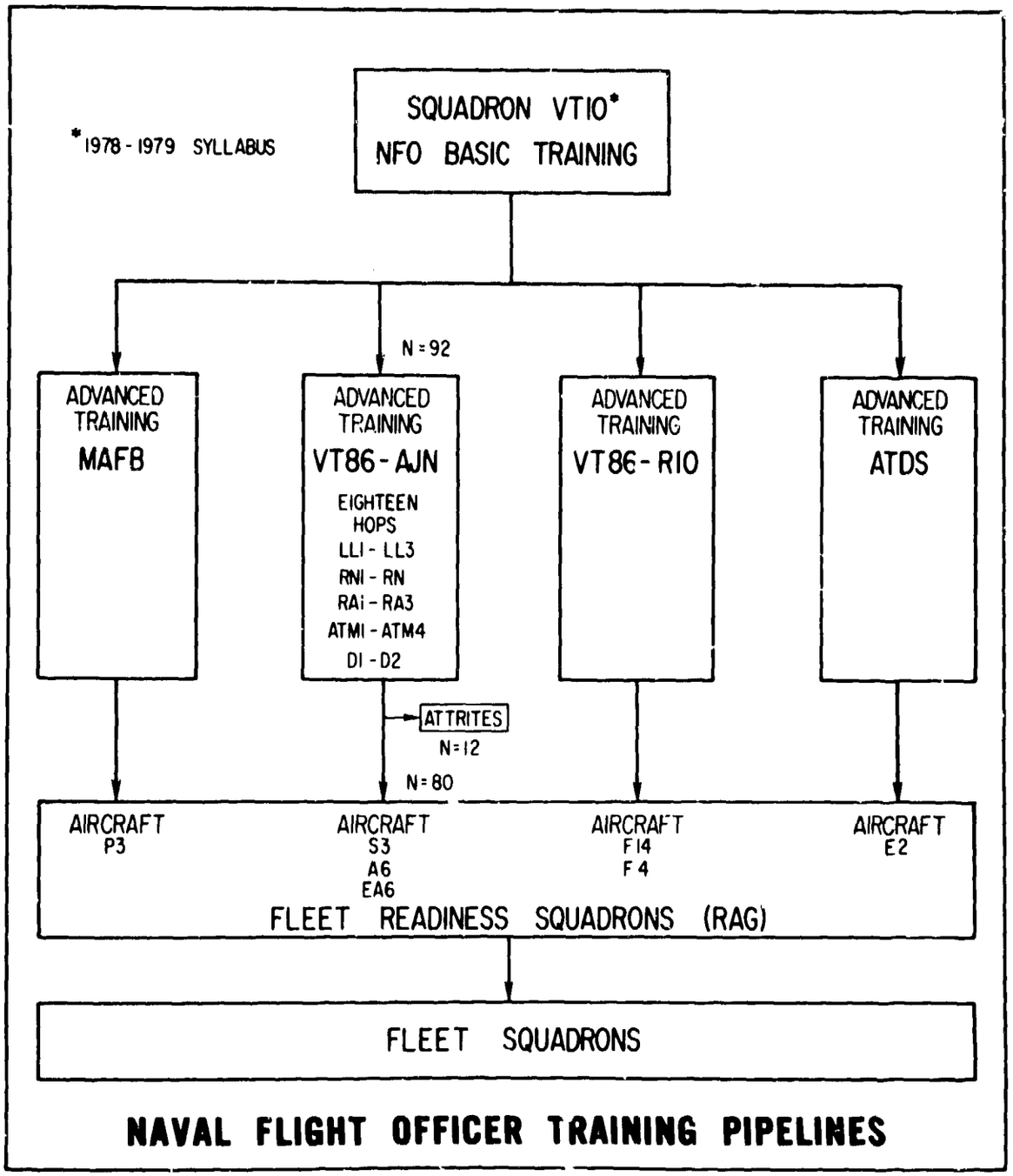

Figure 1

Block diagram showing training pipelines followed by Naval Flight Officer students beginning with basic training and progressing through various advanced and fleet readiness (RAG) squadrons before receiving fleet assignments. This report deals with airsickness incidence in Advanced Training Squadron VT86-AJN under a new flight syllabus that was phased in during the 1978-1979 period.

which are shown in Figure 2), with the majority of the hops involving the latter aircraft. Brief descriptions of the 18 hops comprising the new (current) syllabus are presented in Appendix A. Upon completing advanced/secondary training, the VT86-AJN students receive additional type-specific training in fleet readiness squadrons (commonly referred to as RAG squadrons) before being assigned to an operational fleet squadron.

To document the incidence and severity of airsickness experienced by the VT86-AJN students, the questionnaire developed for the initial study (3) was again used. One questionnaire was completed for each hop flown, with separate sections provided for student and instructor evaluations of the student's airsickness reactions. Upon completion of his questionnaire, the student folded and sealed the form so that the instructor's ratings were made independently. For the student questionnaire, the key elements were four forced-choice ratings of airsickness experienced during the flight, number of times vomiting occurred, flight performance degradation as a result of airsickness, and any nervousness experienced before or during flight. A fifth item requested a yes or no answer concerning the use of airsickness medication on the hop. The instructor also provided ratings of the same airsickness, vomiting, performance degradation, and nervousness parameters rated by the student. In addition, the instructors were asked to rate the roughness of flight; i.e., atmospheric turbulence encountered on the hop.

The motion reactivity test data presented for this population of students were collected prior to the time the NFO students began their basic/primary training in Squadron VT10. Brief descriptions of these tests are provided in Appendix B, with related references that provide more detailed information on test techniques and procedures. The general methods used in the computer storage of these motion reactivity test data and the related flight airsickness data are outlined in the first report (3) of the series.

RESULTS AND DISCUSSION

A total of 1,552 validated airsickness questionnaires involving 92 VT86-AJN students were collected during this phase of the longitudinal study. As indicated in Figure 1, of the total of 92 students for which flight data were available, 80 (86.9 percent) graduated from the squadron, while 12 (13.0 percent) of the students attrited before completing training. (This attrition rate is about the same as that noted in the first VT86-AJN report [4].) Of the total number of attrites, one student dropped out of the program at his own request, and the remaining 11 were dismissed as a result of inadequate academic or flight performance.

The study results are reported and discussed under eight different subheadings in general conformance with the format used in the first VT86-AJN report (4). In the first section the data derived from the student and instructor questionnaires are used to define the incidence and severity of airsickness on each of the hops comprising the Squadron VT86-AJN syllabus (post-1978). In the second section the questionnaire

Figure 2

Photographs of the TA-4J (top) and T39-D (bottom) aircraft used in the Squadron VT86-AJN flight syllabus.

data are discussed in relation to the contribution of students experiencing repeated airsickness to the over-all airsickness incidence figures. In the third section unweighted and weighted airsickness indices are developed on an individual-student basis to quantitatively define the airsickness experiences of the squadron population as a whole. That section also includes statistics describing the performance of the students who received laboratory motion reactivity tests before they began NFO training. The fourth section provides a brief comparison of the airsickness indices and laboratory test scores of the students who graduated from the squadron with those of the students who attrited prior to graduation. The fifth section utilizes the flight indices to both define and compare the performance of nonsusceptible student groups with the most susceptible student groups within the over-all population. The sixth section presents a rank correlation matrix analysis of the relationships found to exist between and across the different flight indices and laboratory test scores. The seventh section compares the VT86-AJN advanced squadron airsickness indices with the VT10 basic squadron indices of the same students. The last section compares the flight and laboratory data produced by the student population of this study who flew the new/current VT86-AJN syllabus with the same form of data produced by the student population of the original VT86-AJN study (4) who flew a different syllabus.

AIRSICKNESS INCIDENCE AND SEVERITY: INDIVIDUAL-HOP BASIS

The airsickness and related response measures derived from the questionnaires are tabulated in Table I for each of the 18 hops comprising the VT86-AJN syllabus. The table contains separate listings for the student and instructor ratings of the incidence and relative magnitude of the four principal response measures of the study; i.e., airsickness, vomiting, inflight performance degradation caused by airsickness, and nervousness. For each of those measures, four percentage values corresponding to classifications present, mild, moderate, severe are presented for each of the 18 hops. Each datum below a given hop name (see Appendix A for a brief description of each hop) represents the percentage of the total number of hops flown of the given type where the denoted response occurred. The first datum presented for a given response, e.g., "Airsickness-Present," is the percentage of the hops where airsickness was present without qualification as to the magnitude (mild, moderate, or severe) of the response. The three subsequent data describe the percent incidence of mild, moderate, and severe ratings, respectively, for the denoted questionnaire item. In the case of the vomiting measure, the breakdown is based upon the number of times the response occurred on a given flight. The student questionnaire tabulation also contains a line item describing the percent incidence of flights where the students reported that airsickness medication was used. In the instructor tabulation, separate listings are provided for flight turbulence and a breakdown of the grades issued on a given hop. The data presented in the "Total" column at the extreme right in the table represent the percentage of the total number of hops flown (1,552) where the denoted responses were present.

Table I

Percent incidence of airsickness and related flight questionnaire responses on the 18 hops comprising the new (1979) flight syllabus of Advanced Training Squadron VT86-AJN. The student and instructor questionnaire data are listed separately with each datum shown below a given hop representing the percentage of the total hops flown of the given type where the denoted response occurred. The total column at the right represents the percent incidence of a given response based upon all 1,552 hops flown by the 92 NFO students comprising this specific study population.

FLIGHT QUESTIONNAIRE RESPONSES	INDIVIDUAL HOPS COMPRISING SQUADRON FLIGHT SYLLABUS																		
	LL1	LL2	LL3	RN1	RN2	RN3	RN4	RN5	RA1	RA2	[illegible]	RA3	D2	D1	ATM1	ATM2	ATM3	ATM4	TOTAL
HOPS FLOWN-PERCENT OF TOTAL	5.7	7.2	9.1	5.3	5.8	5.9	5.7	6.6	6.3	5.5	3.9	5.6	4.6	5.8	4.6	4.3	4.8	4.1	100.
S-AIRSICKNESS-PRESENT	28.1	17.1	2.8	1.2	2.2	5.5	2.3	5.8	2.8	1.2	1.6	3.4	37.5	44.9	50.8	28.8	10.8	10.9	13.1
S-AIRSICKNESS-MILD	23.6	17.1	1.4	1.2	2.2	4.4	2.3	5.8	2.8	1.2	1.6	3.4	30.6	24.4	29.2	18.2	8.1	6.2	9.5
S-AIRSICKNESS-MODERATE	4.5	.0	1.4	.0	.0	1.1	.0	.0	.0	.0	.0	.0	4.2	19.2	12.5	10.6	2.7	4.7	3.8
S-AIRSICKNESS-SEVERE	.0	.0	.0	.0	.0	.6	.0	.0	.0	.0	.0	.0	2.8	1.3	8.3	.9	.0	.0	.6
S-VOMITING-PRESENT	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	23.6	24.4	27.8	10.6	5.4	4.7	4.6
S-VOMITING-1 TIME	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	13.9	11.5	15.3	7.6	5.4	.0	2.6
S-VOMITING-2 TIMES	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	5.6	6.4	2.8	.0	.0	3.1	.8
S-VOMITING-3 OR MORE TIMES	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.4	9.7	3.8	.0	1.6	1.2
S-PERF DEGRADATION-PRESENT	4.5	2.7	1.4	1.2	1.1	1.1	.0	3.9	1.0	.0	.0	.0	15.3	25.6	26.4	12.1	5.4	9.4	5.5
S-PERF DEGRADATION-MILD	4.5	1.9	1.4	1.2	1.1	1.1	.0	2.9	1.0	.0	.0	.0	9.7	20.5	15.3	10.6	4.1	6.2	4.1
S-PERF DEGRADATION-MODERATE	.0	.0	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	4.2	5.1	6.9	1.5	1.4	3.1	1.1
S-PERF DEGRADATION-SEVERE	.0	.9	.0	.0	.0	.0	.0	.9	.0	.0	.0	.0	1.4	.0	4.2	.0	.9	.0	.3
S-NERVOUSNESS-PRESENT	47.2	35.1	36.2	25.6	25.6	24.2	25.0	35.9	30.6	32.9	24.6	24.1	31.9	48.7	48.6	34.8	28.4	31.2	32.9
S-NERVOUSNESS-MILD	36.0	33.3	30.5	23.2	23.3	24.2	22.7	33.0	29.6	24.7	23.0	23.0	29.2	42.3	44.4	33.3	27.0	25.8	29.3
S-NERVOUSNESS-MODERATE	11.2	1.8	5.0	2.4	2.2	.0	2.3	2.9	2.8	7.1	1.6	1.1	2.8	6.4	4.2	1.5	1.4	6.2	3.5
S-NERVOUSNESS-SEVERE	.0	.0	.7	.0	.0	.0	.0	.0	.0	1.2	.0	.0	.0	.0	.0	.9	.0	.0	.1
S-MEDICATION USED ON HOP	.0	.0	.0	1.2	.0	1.1	.0	.0	.0	.0	.0	.0	4.2	2.6	13.9	13.6	12.2	6.2	2.5
I-AIRSICKNESS-PRESENT	5.6	.0	.0	1.2	.0	.0	1.1	1.9	2.8	.0	.0	1.1	26.4	28.2	34.7	13.6	8.1	7.8	6.3
I-AIRSICKNESS-MILD	4.5	.0	.0	1.2	.0	.0	1.1	1.9	2.8	.0	.0	1.1	18.1	21.8	20.8	10.6	5.4	3.1	4.4
I-AIRSICKNESS-MODERATE	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	5.6	6.4	8.3	3.0	2.7	4.7	1.5
I-AIRSICKNESS-SEVERE	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.8	.0	5.6	.0	.0	.0	.4
I-VOMITING-PRESENT	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	18.1	23.1	25.0	7.6	5.4	6.2	4.1
I-VOMITING-1 TIME	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	11.1	15.4	13.9	6.1	4.1	1.6	2.6
I-VOMITING-2 TIMES	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.4	2.8	.0	1.4	3.1	.8
I-VOMITING-3 OR MORE TIMES	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.8	1.3	8.3	1.5	.0	1.6	.7
I-PERF DEGRADATION-PRESENT	.0	.0	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	15.3	19.2	19.4	7.6	8.1	4.7	3.5
I-PERF DEGRADATION-MILD	.0	.0	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	9.7	16.7	12.5	7.6	6.9	4.7	2.8
I-PERF DEGRADATION-MODERATE	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	5.6	2.6	2.8	.9	1.4	.0	.6
I-PERF DEGRADATION-SEVERE	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	.0	.0	.0	.2
I-NERVOUSNESS-PRESENT	13.5	15.3	15.6	7.3	14.4	6.6	8.0	12.6	9.2	12.9	6.6	8.0	8.3	15.2	18.1	9.1	9.5	15.6	11.9
I-NERVOUSNESS-MILD	12.4	14.4	12.8	7.3	14.4	6.6	5.7	10.7	8.2	12.9	5.9	6.9	8.3	16.7	15.3	9.1	9.5	15.6	10.8
I-NERVOUSNESS-MODERATE	1.1	.9	2.1	.0	.9	.0	2.3	1.9	1.0	.0	1.6	1.1	.0	2.6	2.8	.0	.9	.0	1.8
I-NERVOUSNESS-SEVERE	.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.9	.0	.9	.0	.1
I-TURBULENCE-PRESENT	28.1	28.9	21.3	7.3	17.8	14.3	22.7	28.2	21.4	12.9	6.6	11.5	29.2	30.8	55.6	48.5	48.5	51.6	25.6
I-TURBULENCE-MILD	22.5	27.0	15.6	7.3	14.4	12.1	18.2	28.4	18.4	11.8	6.6	8.0	16.7	19.2	34.7	15.2	5.4	18.9	16.2
I-TURBULENCE-MODERATE	5.6	1.8	5.7	.9	3.3	1.1	4.5	7.8	3.1	1.2	.0	3.4	12.5	21.5	28.8	32.3	32.4	39.1	9.1
I-TURBULENCE-SEVERE	.0	.0	.0	.0	.0	1.1	.0	.9	.0	.9	.0	.0	.0	.9	.0	.9	2.7	1.6	.3
I-FLT GRADES-ISSUED ON HOP	94.4	98.2	96.5	98.8	92.2	97.8	97.7	97.1	94.9	94.1	98.4	94.3	95.8	96.2	95.8	95.5	95.9	93.7	96.8
I-FLT GRADES-UNSATISFACTORY	.1	.4	1.8	.0	.1	.1	.2	.3	.5	.3	.1	.5	.7	.3	.5	.2	.3	.1	.3
I-FLT GRADES-BELOW AVERAGE	5.4	7.0	8.2	3.0	5.0	5.0	4.6	5.4	6.9	5.3	3.6	3.4	5.1	4.7	6.0	5.4	6.7	7.2	5.5
I-FLT GRADES-AVERAGE	89.4	85.2	83.9	89.8	88.7	96.9	97.4	85.9	94.1	84.4	96.9	83.2	82.8	85.9	81.5	87.3	84.6	82.8	85.8
I-FLT GRADES-ABOVE AVERAGE	6.0	7.4	7.0	7.2	6.2	8.0	7.7	8.4	9.5	10.0	9.4	12.8	11.4	9.1	12.1	7.1	8.4	10.6	8.4

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

As indicated in the "Total" column of Table I, the VT86-AJN students reported that airsickness was present on 13.1 percent of the total hops flown during training in this squadron, vomiting occurred on 4.6 percent of the total hops, and inflight performance degradation due to airsickness resulted on 5.5 percent of the hops. These data indicate that airsickness associated with the new VT86-AJN flight syllabus was of greater magnitude than that with the old syllabus, where the students reported (4) incidence figures corresponding to those above of 8.6, 3.7, and 3.4 percent, respectively. The corresponding instructor-based data for the new and old flight syllabi also reflect a higher airsickness incidence in the new syllabus.

To illustrate the relative magnitude of the airsickness problem among the different hops comprising the Squadron VT86-AJN flight syllabus, selected elements of Table I have been plotted in Figures 3 through 9. In these figures, each hop is identified with an abbreviated code that is explained in Appendix A. The hop name-labeling sequence in these figures reading from left to right follows, in general, the sequence that the students flew the hops, although there were variations from student to student. The one exception in the labeling sequence is the D series of hops where D1 was flown before D2.

The distribution of the basic flight data available for analysis for each hop is depicted in Figure 3 where the number of questionnaires collected for a given hop is expressed as the percentage of the total number (1,552) of questionnaires received. Variations in the exact number of questionnaires received per hop are due to less than 100 percent return, which was partially compensated by repeat hops flown by some students.

In Figure 4 the student and instructor ratings of airsickness are compared for each hop. Figure 4A plots the incidence of airsickness, regardless of degree of severity, that occurred on a given hop as the percentage of the total hops flown where airsickness was present. Figures 4B, 4C, and 4D depict the percent incidence of hops where airsickness was present to a mild, moderate, and severe degree, respectively. Figures 5, 6, and 7 represent equivalent plots of the incidence of vomiting, inflight performance degradation due to airsickness, and nervousness, respectively. A comparison of the relative level of the student and instructor judgments in these four figures indicates the general trend for the instructors to underestimate the students' estimates of their own reactions. As indicated in Figure 4A, the first hop of the syllabus, LL1, resulted in airsickness on approximately 28 percent of the flights based upon the student ratings. Airsickness incidence decreased to approximately 17 percent on LL2 and then fell to a relatively low level on the following ten hops. These first twelve hops were all flown in the T39-D aircraft. However, when the D and ATM series of hops, flown in the higher performance TA-4J aircraft, were encountered, airsickness incidence rose sharply, reaching a peak level of 50 percent on ATM1. These hops, involving TA-4J familiarization and demonstration of advanced tactical maneuvers, also resulted in a high incidence of vomiting compared with that which occurred on LL1. As shown in Figure 5A, vomiting

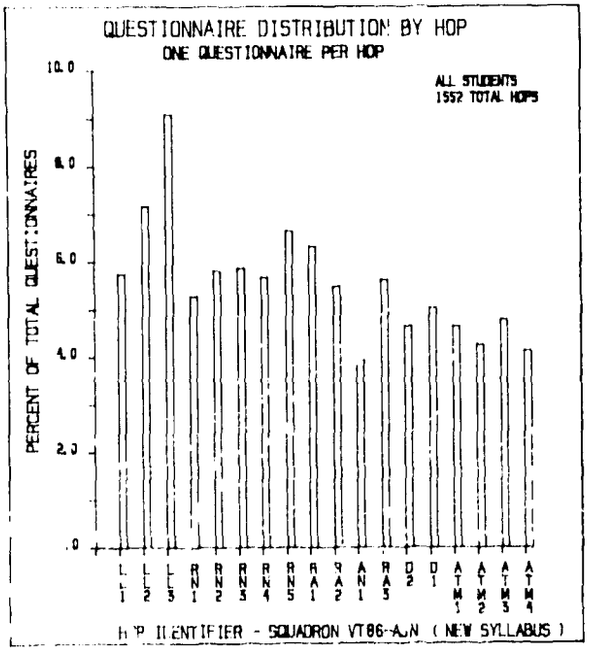

Figure 7

Plot of relative distribution of airsickness questionnaires received during the study as a function of the individual hops comprising the squadron flight syllabus. Each bar above a given hop corresponds to the percentage of the total number of questionnaires collected during the study that pertained to the specific hop. The left-to-right hop sequence shown corresponds in general to the sequence that the students flew the hops, although there were exceptions within each hop series.

was reported by the students to have occurred on nearly 28 percent of the ATM1 hops.

Figure 8 is a plot of the percent incidence of airsickness medication usage as reported by the students. These data indicate a relatively low dependence on medication during the early phase of training followed by a significant increase at the time of the D and ATM series of hops. As stated previously (3-6), this reported usage of medication during the mid-to-late phases of the flight syllabus requires further investigation since this practice tends to allow airsick susceptibles to continue in the program without the natural screening or attrition that might occur without medication.

The instructor ratings of turbulence shown in Figure 9 indicate a higher degree of roughness of air for the ATM series of hops as compared to the other hop series in the syllabus. As has been mentioned previously (3-6), this probably arises from the wording used in the questionnaire item dealing with the roughness of air encountered on a given flight. As a result of the inclusion of the words, "pilot technique," in the question, some instructors were led to rate a given hop in terms of the flight forces produced by the maneuvers associated with the hop, rather than the atmospheric turbulence or buffeting that was present.

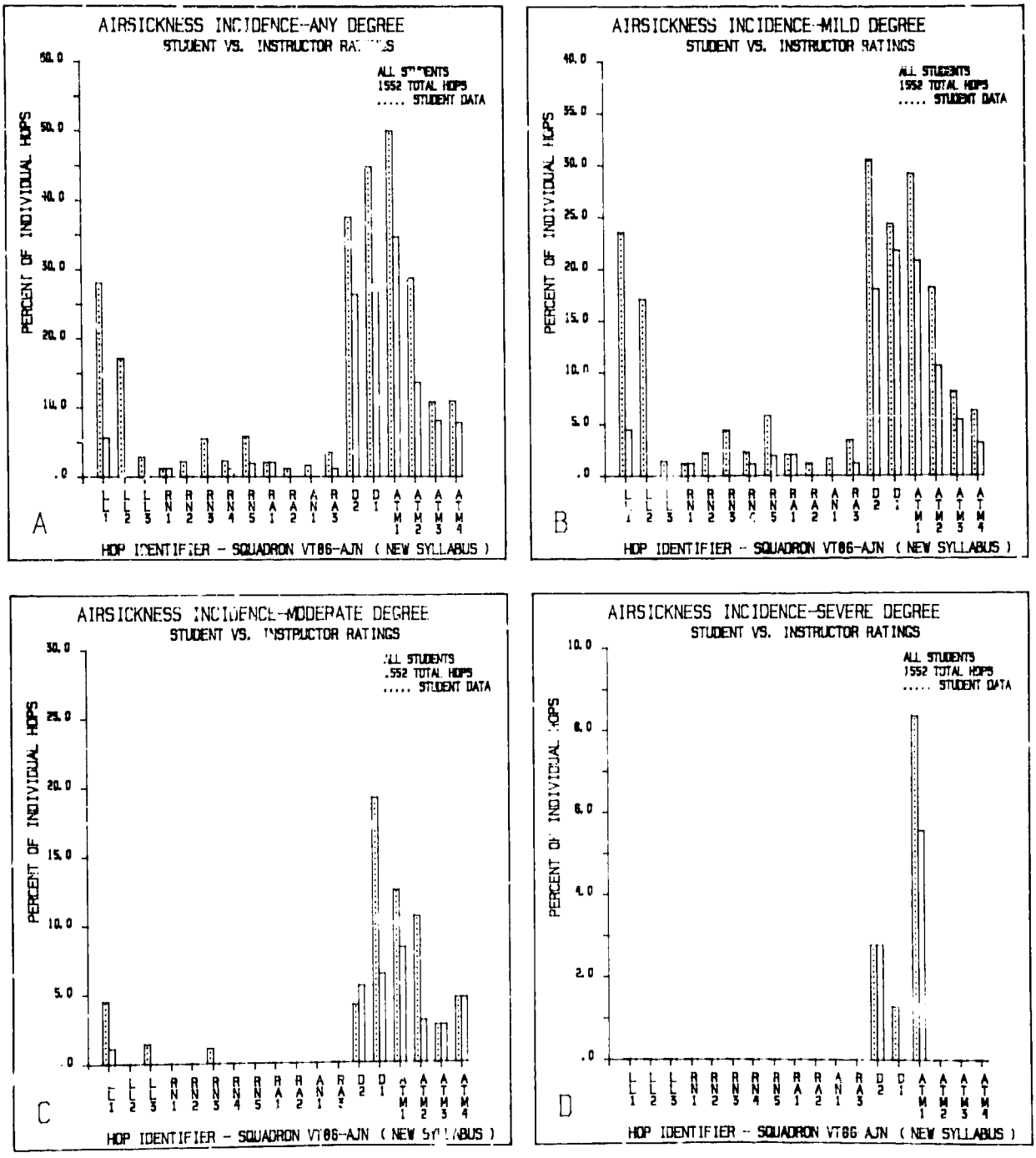

Figure 4

Comparison of student and instructor ratings of airsickness incidence and severity as a function of the individual hops. The incidence of airsickness of any degree (mild, moderate, or severe) is shown in A; the incidence of mild, moderate, and severe degrees of airsickness in B, C, and D, respectively. In each case, incidence is expressed as the percentage of the total number of hops flown of a given classification where the denoted response occurred. In general, the instructor judgments of airsickness incidence and severity underestimate those provided by the students. Greatest airsickness stress was produced on hops LL1 and LL2 during the early part of the syllabus and hops D1, D2, ATM1, and ATM2 during the later phase.

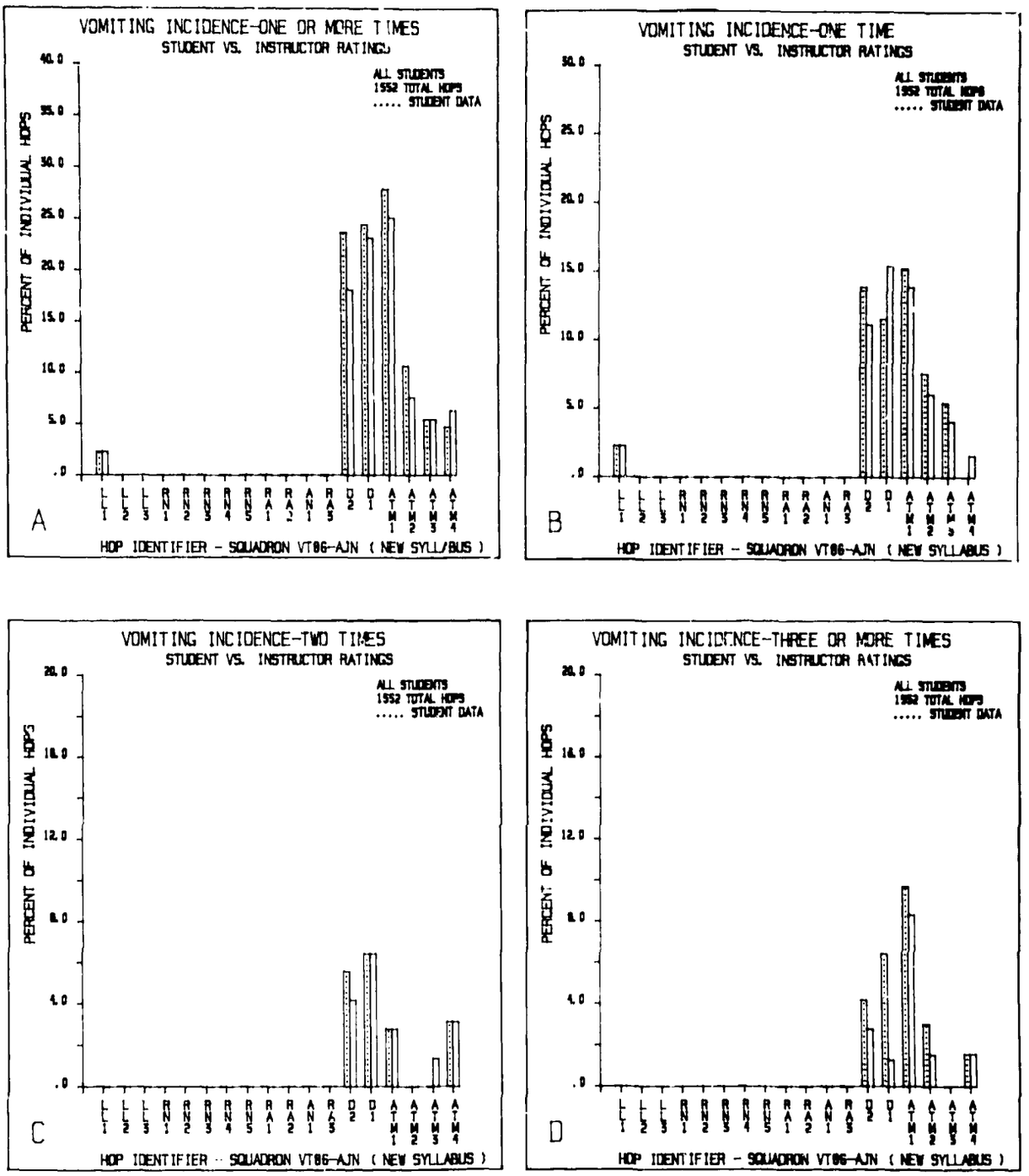

Figure 5

Comparison of student and instructor ratings of vomiting incidence as a function of the individual hops. The percent incidence of hops resulting in students vomiting one or more times is shown in A; the incidence of hops where the students vomited one, two, three, or more times is shown in B, C, and D, respectively. Vomiting incidence was greatest toward the end of the syllabus.

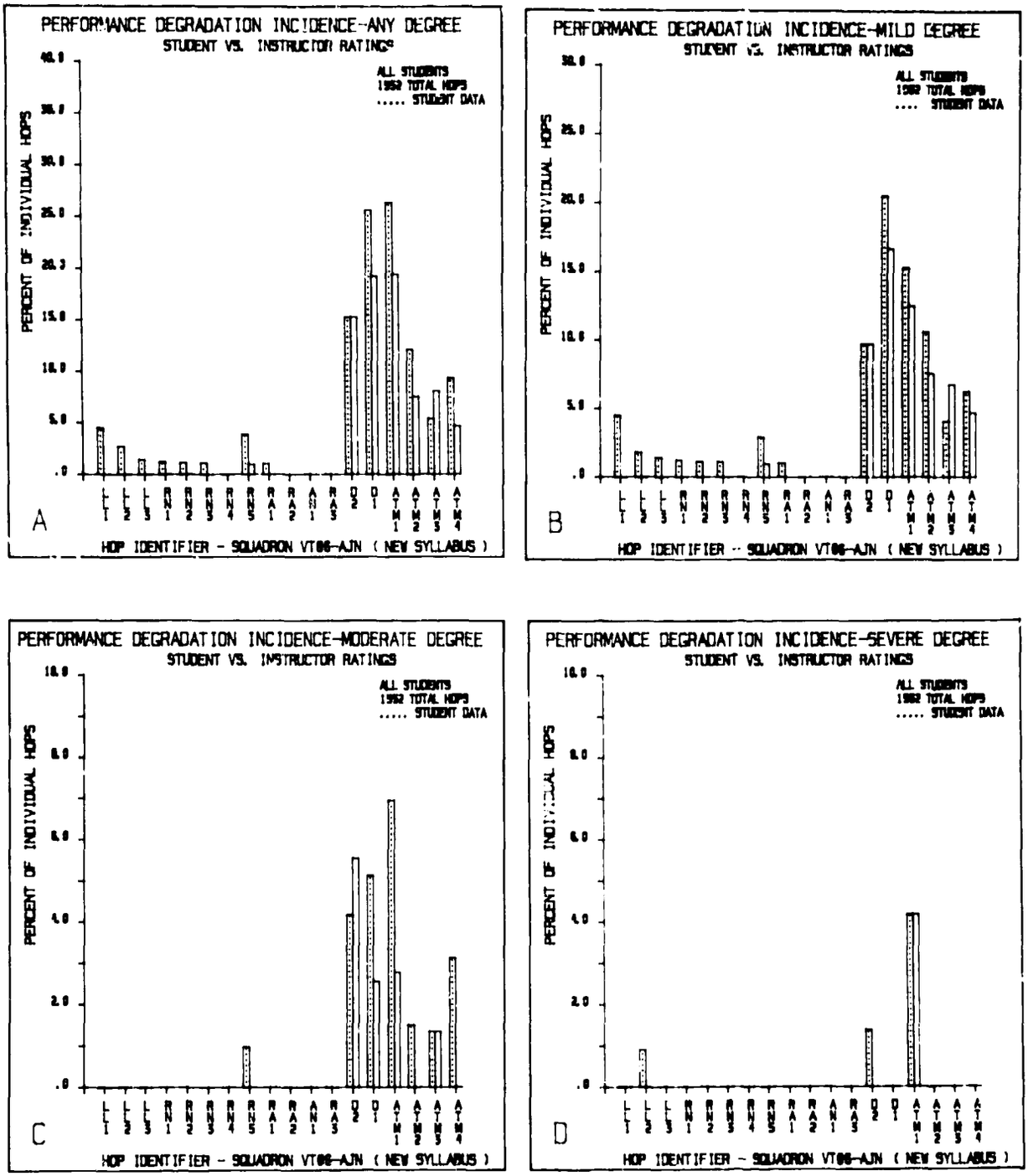

Figure 6

Comparison of student and instructor ratings of inflight performance degradation caused by airsickness as a function of the individual hops.

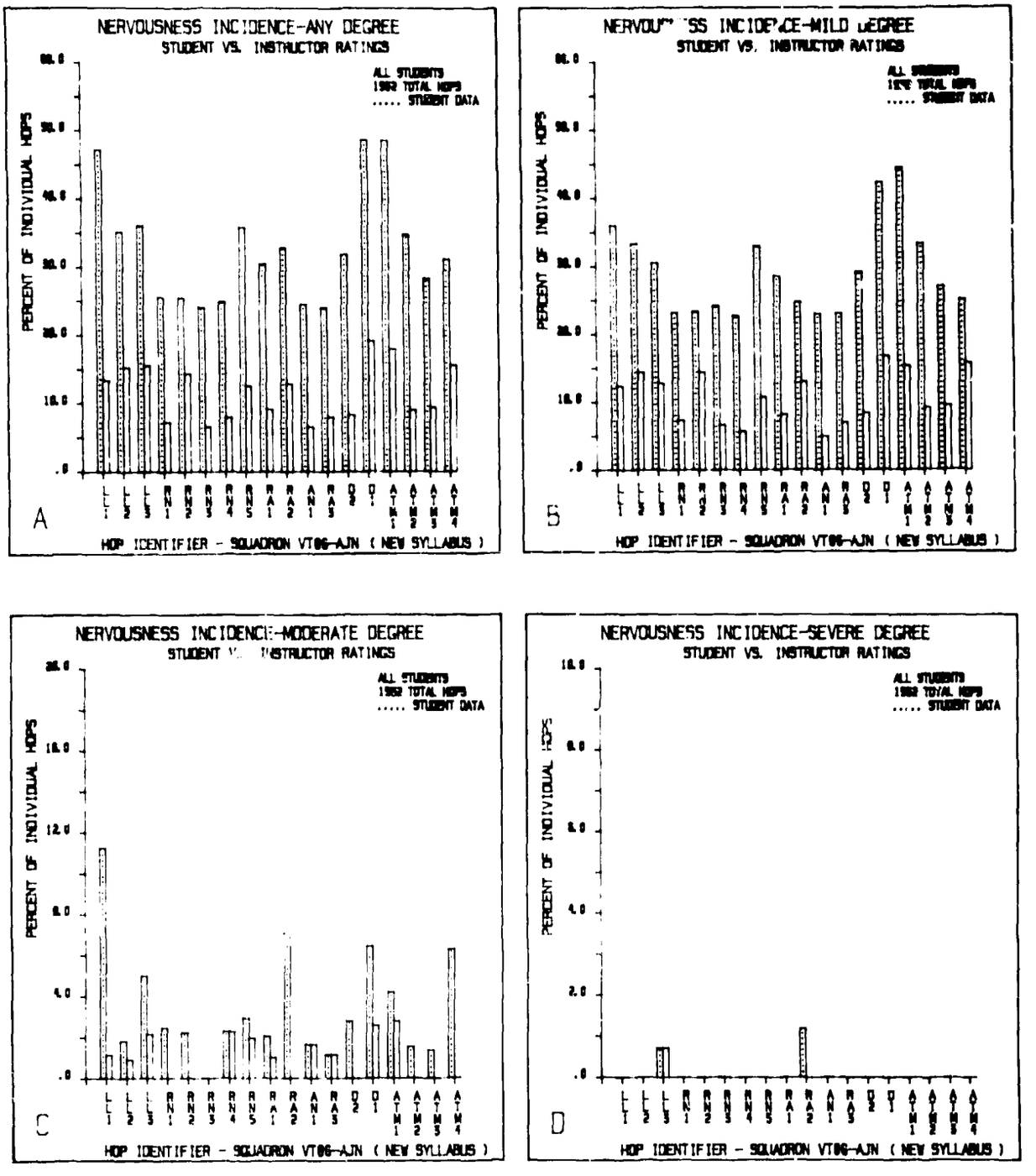

Figure 7

Comparison of student and instructor judgments of student nervousness before or during a given flight as a function of the individual hops.

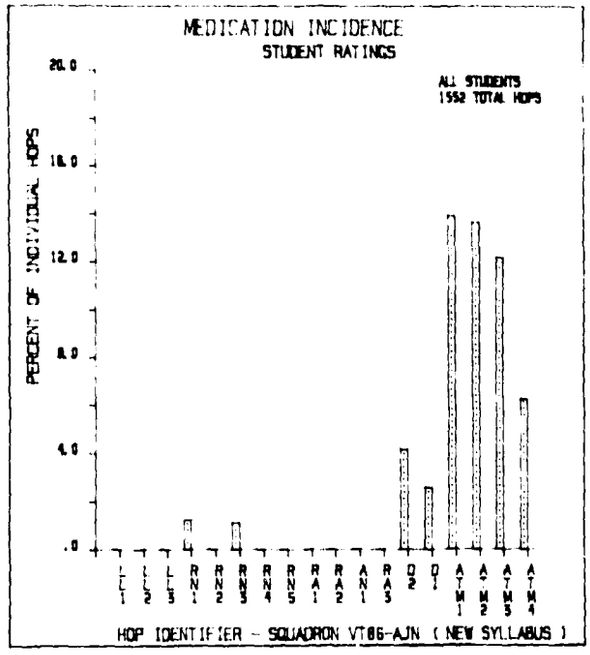

Figure 8

Percent incidence of flights where students reported using airsickness medication. This squadron reported little usage of medication until late in the syllabus when the D and ATM series of hops were flown.

In the previous reports (3-6) dealing with airsickness incidence in Squadrons VT-10 and VT-86, it was observed that certain hops flown near the end of the flight syllabus produced relatively high airsickness incidence. This finding was used to emphasize the point that adaptation effects cannot be deduced from a simple analysis of airsickness as a function of the number of hops flown within a given squadron. That is, airsickness incidence, at least for the NFO population, did not continuously decrease as the students progressed through the flight syllabus. The airsickness data for the D and ATM series of hops reflect the same trend for this squadron. Again, these results suggest that conclusions concerning airsickness adaptation must be carefully weighed in relation to the motion stress level of each hop within a given flight syllabus.

AIRSICKNESS INCIDENCE AND SEVERITY: STUDENT FREQUENCY ANALYSIS

The flight data were also analyzed to establish the number of students who experienced a given response a repeated number of times during the course of their training. Table II is a tabulation of the results of this analysis for each of the principal questionnaire responses. Each datum in this table below a given column heading denotes the percentage of the total number of students who experienced a given response the number of times indicated by the column header. For example, the data presented in the first row of Table II indicate that 17.4 percent of the students reported experiencing airsickness on only one hop, 16.3

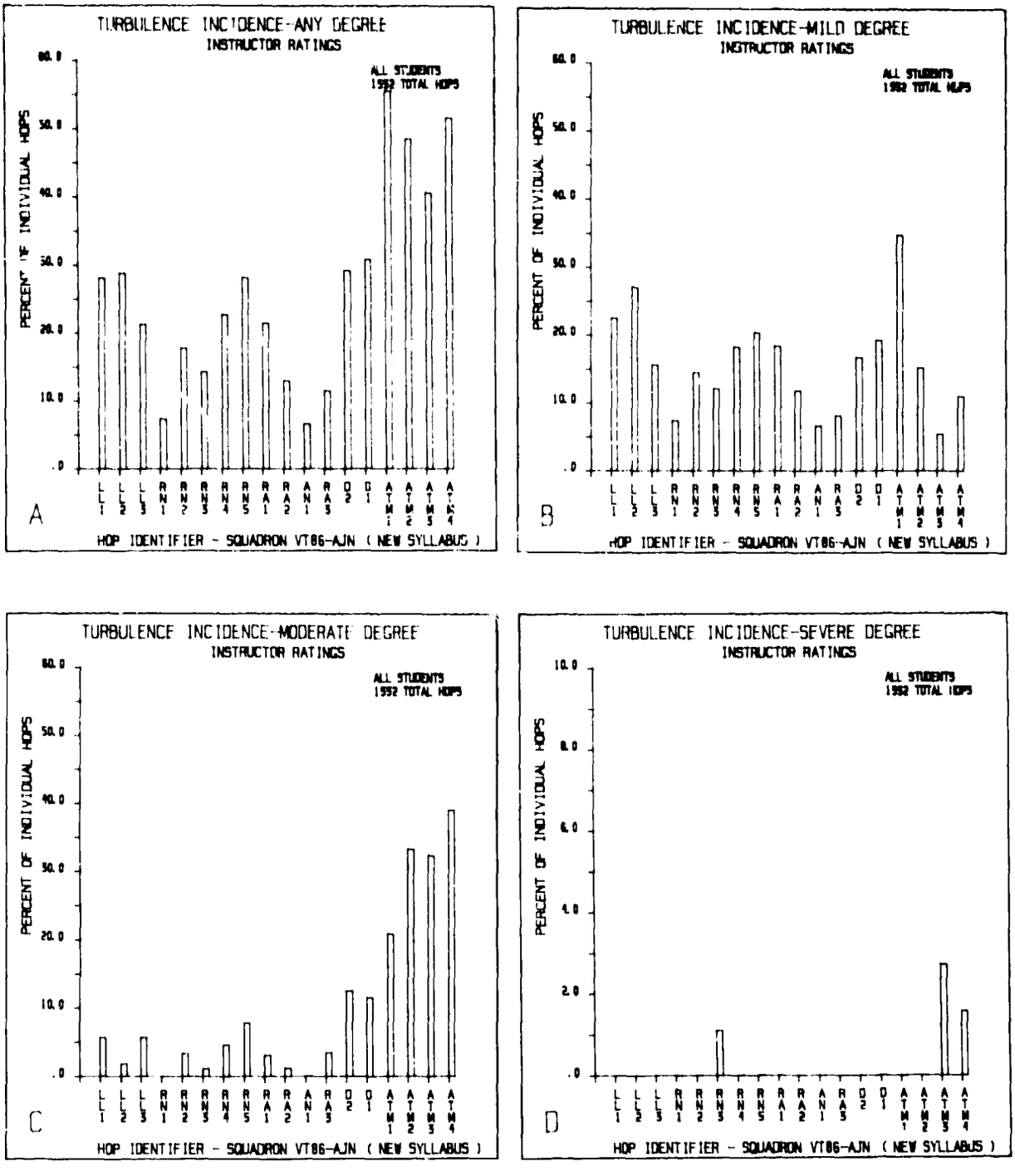

Figure 9

Percent incidence of turbulence (rough air or pilot technique) as a function of the individual hops.

Table II

Relative incidence of students experiencing repeated airsickness a different number of times during flight training in Squadron VT86-AJN. Each datum listed beneath a given column number represents the percentage of the total student population (N = 92) that experienced a given response the denoted number of times. The total column at the right represents the percentage of the total population that experienced a given response one or more times during flight training.

FLIGHT QUESTIONNAIRE RESPONSES	NUMBER OF TIMES RESPONSE EXPERIENCED																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
S-AIRSICKNESS-PRESENT	17.4	16.3	16.3	7.6	4.3	1.1	2.2	3.3	1.1	.0	1.1	.0	.0	.0	.0	.0	.0	.0	78.7
S-AIRSICKNESS-MILD	18.5	21.7	14.1	2.2	5.4	2.2	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	65.2
S-AIRSICKNESS-MODERATE	17.4	10.9	2.2	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	31.5
S-AIRSICKNESS-SEVERE	7.6	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	8.7
S-VOMITING-PRESENT	14.1	13.0	3.3	2.2	2.2	.0	.0	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	35.9
S-VOMITING-1 TIME	15.2	6.5	2.2	1.1	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	26.1
S-VOMITING-2 TIMES	14.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	14.1
S-VOMITING-3 OR MORE TIMES	12.0	2.2	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	15.2
S-PERF DEGRADATION-PRESENT	19.6	8.7	5.4	3.3	2.2	1.1	.0	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	41.3
S-PERF DEGRADATION-MILD	22.8	7.6	5.4	2.2	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	39.1
S-PERF DEGRADATION-MODERATE	9.8	1.1	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	13.0
S-PERF DEGRADATION-SEVERE	3.3	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.3
S-NERVOUSNESS-PRESENT	7.6	13.0	10.9	7.6	10.9	5.4	1.1	.0	2.2	.0	.0	1.1	4.3	3.3	.0	2.2	.0	9.8	79.3
S-NERVOUSNESS-MILD	7.6	15.2	12.0	9.8	9.7	4.3	.0	.0	1.1	.0	1.1	4.3	2.2	3.3	1.1	1.1	.0	6.5	78.3
S-NERVOUSNESS-MODERATE	10.9	7.6	2.2	1.1	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.1	.0	.0	.0	23.9
S-NERVOUSNESS-SEVERE	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.2
S-MEDICATION USED ON HOP	3.3	6.5	2.2	2.2	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	16.3
I-AIRSICKNESS-PRESENT	22.8	8.7	9.8	4.3	2.2	.0	.0	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	48.9
I-AIRSICKNESS-MILD	23.9	13.0	5.4	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	44.6
I-AIRSICKNESS-MODERATE	9.8	5.4	.0	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	16.3
I-AIRSICKNESS-SEVERE	4.3	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	5.4
I-VOMITING-PRESENT	15.2	9.8	2.2	2.2	2.2	.0	.0	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	32.6
I-VOMITING-1 TIME	17.4	6.5	1.1	1.1	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	27.2
I-VOMITING-2 TIMES	7.6	3.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	10.9
I-VOMITING-3 OR MORE TIMES	9.8	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	10.9
I-PERF DEGRADATION-PRESENT	15.2	7.6	3.3	3.3	.0	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	30.4
I-PERF DEGRADATION-MILD	21.7	3.3	3.3	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	30.4
I-PERF DEGRADATION-MODERATE	5.4	2.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	7.6
I-PERF DEGRADATION-SEVERE	1.1	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.2
I-NERVOUSNESS-PRESENT	22.8	25.0	13.0	7.2	3.3	4.3	3.3	.0	.0	.0	.0	2.2	1.1	.0	.0	.0	.0	.0	75.0
I-NERVOUSNESS-MILD	20.7	25.0	12.0	5.4	2.2	1.1	3.3	.0	.0	.0	1.1	.0	.0	.0	.0	.0	.0	.0	70.7
I-NERVOUSNESS-MODERATE	9.8	2.2	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	13.0
I-NERVOUSNESS-SEVERE	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.1
I-TURBULENCE-PRESENT	15.2	10.9	8.7	10.9	17.4	8.7	9.8	7.6	3.3	.0	.0	1.1	1.1	.0	.0	.0	.0	.0	94.6
I-TURBULENCE-MILD	25.0	27.2	13.0	8.7	4.3	10.9	3.3	.0	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	93.5
I-TURBULENCE-MODERATE	23.9	16.3	16.3	5.4	2.2	.0	1.1	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	66.3
I-TURBULENCE-SEVERE	2.2	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.3

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

percent reported being airsick on two hops, et cetera. The total column at the extreme right in the table denotes the percentage of the total number of students who experienced the given response one or more times.

These total data indicate that 70.7 percent of the students reported being airsick on one or more flights during their VT86-AJN training, 35.9 percent reported vomiting on one or more flights, and 41.3 percent reported inflight performance degradation due to airsickness on one or more flights. These values are larger than those experienced by the old syllabus VT86-AJN students (4) who had corresponding figures of 55.2, 28.4, and 30.6 percent, respectively.

To emphasize the multiple contributions of a small number of students to the over-all airsickness problem, the airsickness, vomiting, performance degradation, and nervousness data derived from both the student and instructor responses have been plotted in cumulative frequency distribution form in Figures 10A, B, C, and D, respectively. In these figures, the deviation between the student and instructor distributions reflects the instructors' tendency to underestimate the presence of a given response, using the student judgments as reference. This applies to all variables except the overt symptom of vomiting, where the instructor and student distributions (Figure 10B) had good correspondence. The percentage of the total number of students who never reported experiencing a given response is represented in these figures by the intersection of the distribution curve with the ordinate axis. That is, 29 percent of the students reported never being airsick, 64 percent reported never vomiting, 59 percent reported never suffering from inflight performance degradation due to airsickness, and 21 percent reported never experiencing nervousness prior to or during flight.

From these distribution data, it can be shown that 50 percent of the hops where airsickness occurred was accounted for by approximately 12 percent of the total number of students; 50 percent of the hops where vomiting occurred was accounted for by 9 percent of the students; 50 percent of the hops involving inflight performance degradation was accounted for by 11 percent of the students; and 50 percent of the hops where nervousness occurred was accounted for by 7.5 percent of the students. As mentioned previously (3) the long-term objective in the development of tests to predict airsickness susceptibility must center on the identification of those individuals falling into the upper part, e.g., the upper decile, of the Figure 10A, 10B, and 10C distributions.

Normalized cumulative frequency distributions of the same form are also plotted for student reports of medication usage in Figure 11A and for instructor ratings of turbulence in Figure 11B. The significance of the medication plot is that only 15 (16.3 percent) of the 92 squadron students reported using medication at some time during training. Of these students, 11 used medication on three or less flights, two on four flights, and two on five flights. As with the previously reported squadron data (3-6), the incidence of medication usage shown in Table I and plotted in Figure 8 was accounted for by a relatively small number of students. The turbulence distribution data of Figure 11B continue to show that the repeated exposure to roughness of air is more evenly

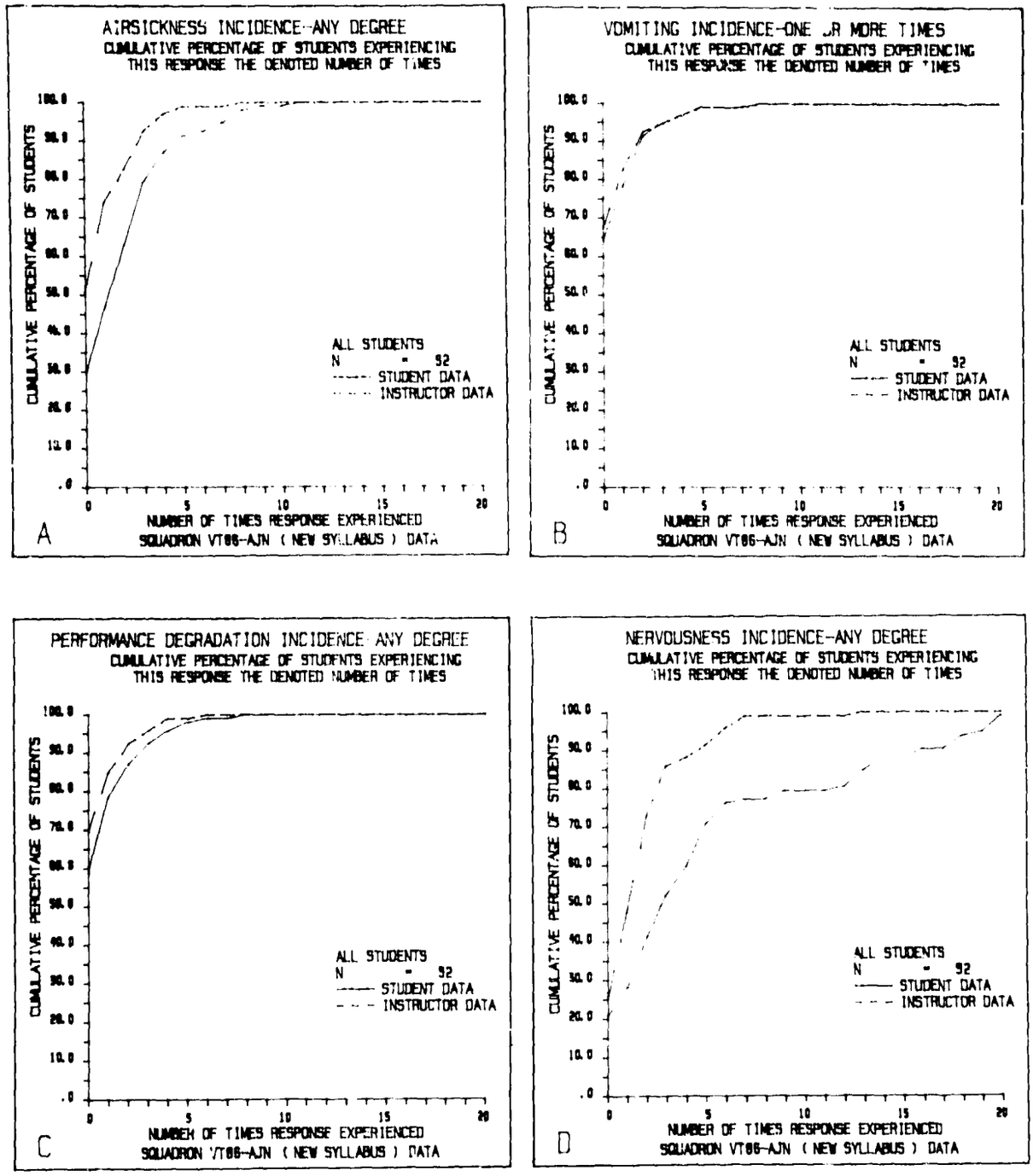

Figure 10

Normalized cumulative frequency distribution of students experiencing airsickness (A), vomiting (B), inflight performance degradation (C), and nervousness (D) a different number of times during the course of their flight training in this squadron based upon both student (solid line) and instructor (dashed line) data.

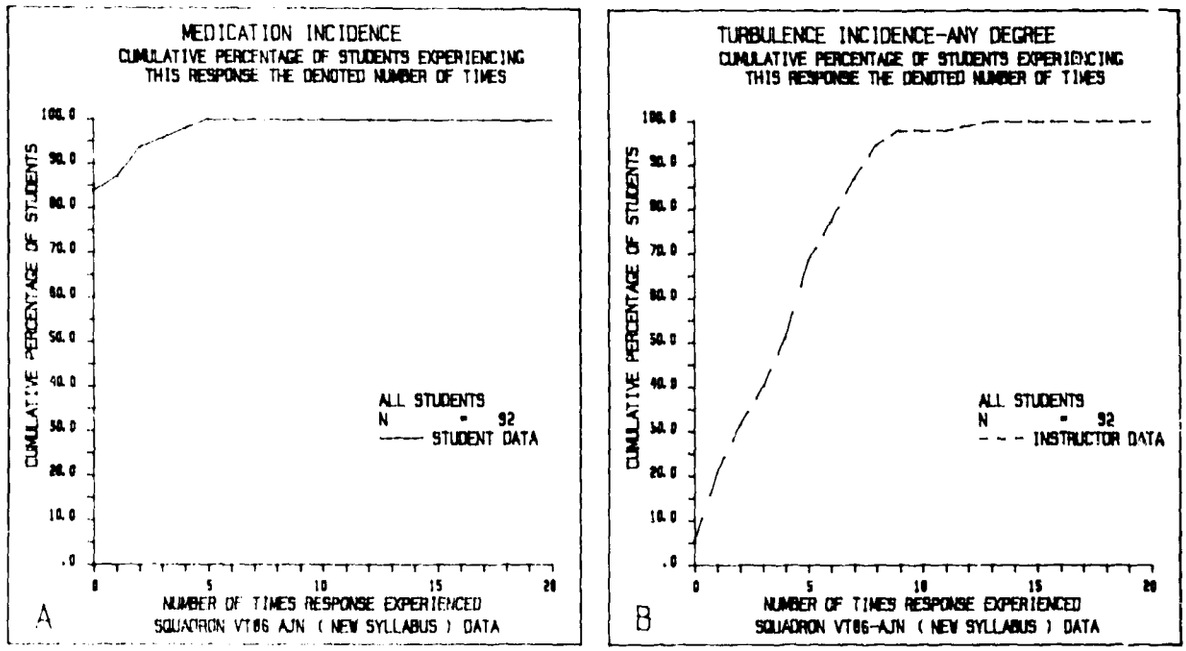

Figure 11

Normalized cumulative frequency distribution of students utilizing medication on a repeated basis (A) and students experiencing turbulence or roughness of air on one or more flights (B). As with all other squadrons studied, only a small percentage of the total student population used airsickness medication.

distributed over the population.

INDIVIDUAL STUDENT PERFORMANCE: AIRSICKNESS INDICES

Unweighted and weighted indices were calculated for the principal components of the airsickness questionnaire data, using both the student and instructor ratings. The indices allow comparisons to be made among different squadrons and among different student subpopulations within given squadrons. In addition, they are intended to serve the further function of relating an individual's performance during basic training with subsequent performance in advanced and fleet readiness (RAG) squadrons. As outlined in the first report (3), five unweighted and five weighted indices were calculated for each student, using the airsickness, vomiting, performance degradation, nervousness, and medication usage components of the student questionnaire as measurement references. Similarly, for the instructor data pertaining to the same student, five unweighted and five weighted indices were calculated, using the same measurement references, with the one exception of substituting the instructor rating of turbulence for the student report of medication

usage. Flight indices were not calculated for those students who submitted less than four questionnaires during the study period.

The methods used to calculate the indices were keyed to structuring a computer data storage file for each student that contained a sequential tabulation of all questionnaires collected from the student during the course of his squadron training. The unweighted indices were calculated from this file as

$$1)\quad \text{RESPONSE INDEX (UNWEIGHTED)} = \frac{\text{No. Flights Response Experienced}}{\text{Total No. Flights Flown}} \times 100$$

where no weight was given to the severity of the response; i.e., attention was given only to the fact that a response such as airsickness occurred on a flight without regard to its mild, moderate, or severe degree of magnitude. Accordingly, the unweighted indices simply represent the percentage of the flights flown by the student where the denoted response such as airsickness occurred. This method of calculation of the unweighted indices was applied to each of the five student questionnaire responses and to each of the five instructor responses, as listed above.

The weighted indices calculated for the same ten questionnaire responses were based upon the assignment of a linear weight of 0, 1, 2, 3 to the four magnitude ratings associated with all but the medication usage item. For example, if a student reported that he was not airsick on a hop, he would have a response rating of 0.0 for this particular flight; a student who reported either mild, moderate, or severe airsickness was given a response rating of 1, 2, or 3, respectively, for a particular hop. These response ratings were summed for all of the hops flown by a given student and used to calculate a weighted index that was normalized to have a maximum value of 100 as follows:

$$2)\quad \text{RESPONSE INDEX (WEIGHTED)} = \frac{\text{Sum (Individual Flight Response Ratings)}}{\text{Total No. Flights Flown}} \times \frac{100}{3}$$

To illustrate, a student who was never airsick during training would have a weighted airsickness response index of 0.0; a student who was severely airsick on all of his flights would have a corresponding weighted index of 100.0; a student who was mildly airsick on 50 percent of his flights would have an index of 16.7; and a student who was severely airsick on 50 percent of his flights would have an index of 50.0. In the case of the medication usage question, a response rating of 0 was assigned to the item if medication was not used on the flight, and 1 if used. The weighted index was also normalized to have a maximum value of 100.0, thus resulting in the unweighted and weighted indices for this one item being identical.

The resulting group statistics for the response indices of the VT-86-AJN students are presented in Table III. Statistical parameters listed for each response variable include the group mean, standard deviation of the observations, standard error of the mean, minimum and maximum values observed, group median, the total number of observations (students) in the data base, and the Kolmogorov-Smirnov deviation statistic.

Table III

Statistical listing of the flight response indices and laboratory test scores for the Squadron VT86-AJN study population. Data presented for each response variable include the mean, standard deviation, standard error of the mean, minimum, maximum, median, and total number of students. In addition, the deviation-statistic associated with the nonparametric Kolmogorov-Smirnov one-sample test of goodness of fit of the distribution of the observed data to the distribution of an equivalent theoretical Gaussian population is listed at the right.

RESPONSE VARIABLE NO.	DESCRIPTION	STATISTICAL PARAMETERS MEAN	S.DEV.	S.ERR.	MIN	MAX	MEDIAN	N	DEV
1	S-AIRSICKNESS INDEX-UW	13.6	13.3	1.4	.0	53.8	11.1	86	.14@
2	S-VOMITING INDEX-UW	4.8	8.6	.9	.0	50.0	.0	86	.31#
3	S-P.DEGRADATION INDEX-UW	5.7	9.0	1.0	.0	46.2	.0	86	.31#
4	S-NERVOUSNESS INDEX-UW	31.5	29.7	3.2	.0	100.0	22.5	86	.19#
5	S-MEDICATION INDEX-UW	2.5	6.3	.7	.0	29.4	.0	86	.46#
6	S-AIRSICKNESS INDEX-W	6.0	6.2	.7	.0	25.6	3.7	86	.10@
7	S-VOMITING INDEX-W	2.6	4.7	.5	.0	21.7	.0	86	.31#
8	S-P.DEGRADATION INDEX-W	2.4	4.3	.5	.0	23.1	.0	66	.25#
9	S-NERVOUSNESS INDEX-W	11.8	11.6	1.3	.0	47.2	7.8	86	.19#
10	S-MEDICATION INDEX-W	2.5	6.3	.7	.0	29.4	.0	86	.46#
11	I-AIRSICKNESS INDEX-UW	6.9	9.5	1.0	.0	50.0	4.3	86	.22@
12	I-VOMITING INDEX-UW	4.5	8.7	.9	.0	50.0	.0	86	.34#
13	I-P.DEGRADATION INDEX-UW	3.7	6.7	.7	.0	33.3	.0	86	.37#
14	I-NERVOUSNESS INDEX-UW	12.9	11.6	1.3	.0	65.0	10.0	86	.15@
15	I-TURBULENCE INDEX-UW	27.3	13.2	1.4	.0	59.1	27.8	86	.07
16	I-AIRSICKNESS INDEX-W	3.1	4.8	.5	.0	23.2	1.4	86	.23#
17	I-VOMITING INDEX-W	2.2	4.4	.5	.0	20.3	.0	86	.34#
18	I-P.DEGRADATION INDEX-W	1.6	3.4	.4	.0	22.2	.0	86	.37#
19	I-NERVOUSNESS INDEX-W	4.7	4.5	.5	.0	23.3	3.6	86	.17@
20	I-TURBULENCE INDEX-W	12.3	6.4	.7	.0	29.0	12.4	86	.08
21	ACADEMIC GRADES-BASIC	49.9	8.0	.8	31.3	64.0	50.8	92	.04
22	FLIGHT GRADES-BASIC	3.0	.0	.0	3.0	3.1	3.0	92	.17#
23	TMSQ1-MS HISTORY:PART 1	7.2	8.6	1.3	.0	33.0	4.5	45	.20@
24	TMSQ2-MS HISTORY:PART 2	4.9	7.2	1.1	.0	27.0	.0	45	.28#
25	TMSQ3-MS HISTORY:SUM	12.1	12.5	1.9	.0	51.0	10.3	45	.21@
26	TSANX-STATE/ANX.QUEST.	30.6	8.2	1.2	20.0	54.0	28.5	44	.16
27	TTANX-TRAIT/ANX.QUEST.	29.3	6.6	1.0	20.0	52.0	28.0	44	.15
28	TBVDT-BVDT TIME OF DAY	8.9	.9	.1	7.7	13.0	8.8	45	.14
29	TBVDR-BVDT RATER	14.9	6.6	1.0	7.0	36.0	13.0	45	.17
30	TBVDS-BVDT SELF-RATING	13.9	6.8	1.0	5.0	30.0	11.0	45	.20@
31	TBVDP-BVDT POST-RATING	4.4	10.3	1.6	.0	48.0	1.0	44	.32#
32	TVVSP1-VVIT STATIC-RIGHT	121.5	10.1	1.5	90.0	129.0	126.0	45	.25#
33	TVVSP2-VVIT STATIC-WRONG	5.1	6.9	1.0	.0	27.0	3.0	45	.23@
34	TVVSP3-VVIT STATIC-OMIT	2.4	4.8	.7	.0	27.0	.0	45	.31#
35	TVVDP1-VVIT DYNAMIC-RIGHT	76.0	35.9	5.4	9.0	129.0	75.0	45	.12
36	TVVDP2-VVIT DYNAMIC-WRONG	9.8	8.2	1.2	.0	28.0	8.0	45	.16
37	TVVDP3-VVIT DYNAMIC-OMIT	43.1	36.8	5.5	.0	120.0	39.0	45	.18
38	TVVIR-VVIT RATER	15.1	6.5	1.0	6.0	35.0	13.0	45	.16
39	TVVIS-VVIT SELF-RATING	13.6	5.7	.8	5.0	25.0	13.0	45	.13
40	TVVIP-VVIT POST-RATING	4.9	9.4	1.4	.0	42.0	1.0	45	.36#
41	TVVIT-VVIT TIME OF DAY	10.1	1.3	.2	7.9	14.2	10.1	45	.10
42	ACADEMIC GRADES-ADVANCED	90.0	4.0	.5	79.2	99.7	90.1	78	.05
43	FLIGHT GRADES-ADVANCED	3.0	.0	.0	2.9	3.1	3.0	78	.06

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .1 LEVEL
# = SIGNIFICANT BEYOND THE .01 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Response variables 1 through 10 in that table represent the response indices derived from the student-based questionnaire data; and variables 11 through 20 correspond equivalently to the indices derived from the instructor-based questionnaire data. (It should be noted that the N value of 86 in this table is less than the 92 students used in the compilation of the Tables I and II data. This arises because the Table III flight indices were not calculated for any student who submitted less than four questionnaires - - in this case, 6 students.)

Variables 23 through 41 in Table III describe the performance of the student group on assorted elements of the motion reactivity test battery given to many of the students prior to their beginning flight training in Squadron VT10. In brief, TMSQ1, TMSQ2, and TMSQ3 (variables 23, 24, and 25, respectively) pertain to a motion sickness history where TMSQ1 and TMSQ2 involve motion sickness experiences prior to and following age 12, with TMSQ3 equal to the sum of the TMSQ1 and TMSQ2 scores; TSANX and TTANX (variables 26 and 27) to a state/trait anxiety test; TBVDT, TBVDR, TBVDS, and TBVDP (variables 28 through 31) to a Brief Vestibular Disorientation Test (BVDT); TVVSP1, TVVSP2, and TVVSP3 (variables 32 through 34) to the static performance element of a Visual/ Vestibular Interaction Test (VVIT); TVVDP1, TVVDP2, and TVVDP3 (variables 35 through 37) to the dynamic performance element of the VVIT; and TVVIR, TVVIS, TVVIP, and TVVIT (variables 38 through 41) to the motion sickness rating element of the VVIT.

In the interpretation of the numerical magnitude of the mean data presented in Table III, it should be realized that for the 20 flight indices, high scores denote poor performance and low scores good performance (or in the case of the turbulence measure, high scores represent greater stress than low scores). Correspondingly, for the majority of the motion reactivity test battery scores, high scores denote either poor performance or greater susceptibility to motion stress. In the case of two test scores (TVVSP1 and TVVDP1), the converse is true in that these two variables pertain to the number of correct responses produced by the students while performing the related test tasks. In the case of the TBVDT and TVVIT variables, no magnitude relationship exists relative to performance in that these measures describe the time of day (24-hour clock) that the BVD and VVI Tests were given to the student group.

As with the questionnaire data collected previously (3-6), the distributions of the 20 Squadron VT86-AJN flight indices are generally skewed toward the lower values of the response scale, with the median values of Table III consistently falling below the related means. Similarly, the results of a Kolmogorov-Smirnov one-sample test of goodness of fit (2) of the normalized cumulative distribution of the observed data to an equivalent Gaussian distribution with the same mean and standard deviation as the observed data indicate non-normality of the data. As indicated by the significance symbols adjacent to the Kolmogorov-Smirnov deviation statistic labeled as DEV in Table III, the null hypothesis that the distribution of the observed data is the same as a Gaussian distribution must be rejected at the .01 significance level or greater

for the vast majority of the 20 flight indices. Plots of the normalized cumulative frequency distributions of the unweighted and weighted flight indices, along with their equivalent theoretical Gaussian distributions, are presented in Figures C1 through C5 of Appendix C for both the student and instructor-derived questionnaire data. Figures C6 through C11 plot similar data for the motion reactivity test results (variables 23 through 41) of the squadron students.

The unweighted, student-based indices in Table III imply that for this specific VT86-AJN population, the mean or "average" student experienced airsickness on 13.6 percent of the hops flown, vomited one or more times on 4.8 percent of the hops, and experienced inflight performance degradation due to airsickness on 5.7 percent of the hops. With the exception of the vomit index, the equivalent unweighted indices calculated from the instructor-furnished data indicate considerably lower mean values for the corresponding variables. This same relationship applies to the weighted indices presented in Table III. The mean value of 2.5 for the medication usage index denotes the relatively low usage of medication in the squadron. However, as mentioned in the first report (3) such "average-student" interpretations of the Table III mean data are highly restricted by the non-Gaussian nature of the related distributions.

COMPARISON OF GRADUATED/ATTRITED STUDENT PERFORMANCE

To compare the flight and laboratory performance of the VT86-AJN students who graduated from this squadron with those students who attrited during training in this squadron, a Kruskal-Wallis one-way analysis of variance by ranks test (2) was applied to the data associated with these two subpopulations. In Table IV a tabulation is made of the Kruskal-Wallis H statistic corrected for tied scores; the total number of students included in the analysis; and, for each of the two groups, the mean, standard deviation of the observations, the standard error of the mean, and the number of students included in the group. To disprove the null hypothesis that the two student groups came from the same or identical population requires that the H-statistic equal or exceed 3.84 at the .05 significance level, 6.64 at the .01 level, and 10.83 at the .001 level, assuming that H is distributed like chi square with one degree of freedom. In conformance with the analytical procedures established on an a priori basis in the first report (3) of the series, a probability of .01 was arbitrarily selected as the minimum degree of statistical significance that would be symbolically identified in Table IV (and in all following tables).

In Table IV, the virtual absence of significance symbols adjacent to the H statistic listing indicates that there is little difference between the graduated and attrited subpopulations relative to the vast majority of the flight and laboratory response variables. The only exceptions are the two turbulence indices (variables 15 and 20) and the flight grades (variable 22) received during basic training in Squadron VT10. For these three variables, the mean values were smallest for the attrite group. This lack of statistical differences between the two populations for any of the airsickness-related flight indices was also

Table IV

Results of a nonparametric Kruskal-Wallis one-way analysis of variance comparison of students who graduated from Squadron VT86-AJN with students who attrited from the squadron after beginning flight training.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	GRADUATED MEAN	S.DEV.	S.ERR.	N	ATTRITED MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	1.62	14.0	13.1	1.5	78	10.4	15.9	5.6	8
2	S-VOMITING INDEX-UW	2.69	5.2	8.9	1.0	78	0	2.5	.9	8
3	S-P.DEGRADATION INDEX-UW	.84	5.8	9.0	1.0	78	4.5	10.1	3.6	8
4	S-NERVOUSNESS INDEX-UW	2.31	33.0	30.2	3.4	78	17.1	21.0	7.4	8
5	S-MEDICATION INDEX-UW	1.02	2.7	6.5	.7	78	.0	.0	.0	8
6	S-AIRSICKNESS INDEX-W	1.66	6.1	6.1	.7	78	4.6	7.5	2.6	8
7	S-VOMITING INDEX-W	2.89	2.9	4.8	.5	78	.3	.8	.3	8
8	S-P.DEGRADATION INDEX-W	.96	2.5	4.4	.5	78	1.5	3.4	1.2	8
9	S-NERVOUSNESS INDEX-W	2.01	12.2	11.7	1.3	78	7.5	10.5	3.7	8
10	S-MEDICATION INDEX-W	1.02	2.7	6.5	.7	78	.0	.0	.0	8
11	I-AIRSICKNESS INDEX-UW	1.81	7.3	9.6	1.1	78	3.4	7.2	2.5	8
12	I-VOMITING INDEX-UW	4.40	4.9	9.0	1.0	78	.0	.0	.0	8
13	I-P.DEGRADATION INDEX-UW	1.65	4.0	7.0	.8	78	.9	2.5	.9	8
14	I-NERVOUSNESS INDEX-UW	.35	13.0	11.5	1.3	78	11.7	13.6	4.8	8
15	I-TURBULENCE INDEX-UW	7.53*	20.4	13.0	1.5	78	15.9	9.4	3.3	8
16	I-AIRSICKNESS INDEX-W	2.14	3.3	4.9	.6	78	1.1	2.4	.8	8
17	I-VOMITING INDEX-W	4.40	2.5	4.6	.5	78	.0	.0	.0	8
18	I-P.DEGRADATION INDEX-W	1.65	1.7	3.6	.4	78	.3	.8	.3	8
19	I-NERVOUSNESS INDEX-W	.53	4.8	4.5	.5	78	3.9	4.5	1.6	8
20	I-TURBULENCE INDEX-W	11.60*	13.1	6.2	.7	78	9.3	3.1	1.1	8
21	ACADEMIC GRADES-BASIC	2.75	50.4	7.7	.9	80	46.0	9.3	2.7	12
22	FLIGHT GRADES-BASIC	11.06*	3.0	.0	.0	80	3.0	.0	.0	12
23	TMSQ1-MS HISTORY.PART 1	1.47	7.8	8.7	1.4	37	4.6	8.1	2.9	8
24	TMSQ2-MS HISTORY.PART 2	.60	4.9	6.6	1.1	37	5.2	10.2	3.6	8
25	TMSQ3-MS HISTORY.SUM	1.26	12.6	12.2	2.0	37	9.8	14.4	5.1	8
26	TSANX-STATE/ANX.QUEST.	2.33	31.1	7.5	1.3	36	28.5	11.3	4.0	8
27	TTANX-TRAIT/ANX.QUEST.	.56	29.2	6.9	1.1	36	30.0	5.4	1.9	8
28	TBVDT-BVDT TIME OF DAY	.21	8.9	1.0	.2	37	8.8	.3	.1	8
29	TBVDR-BVDT RATER	1.41	15.4	6.9	1.1	37	12.1	3.9	1.4	8
30	TBVDS-BVDT SELF-RATING	.09	13.9	7.3	1.2	37	13.5	4.3	1.5	8
31	TBVDP-BVDT POST-RATING	.22	5.1	11.3	1.9	36	1.5	2.1	.8	9
32	TVVSP1-VVIT STATIC-RIGHT	1.30	122.7	8.6	1.4	37	116.1	14.8	5.2	8
33	TVVSP2-VVIT STATIC-WRONG	.62	4.8	6.5	1.1	37	6.6	8.9	3.1	8
34	TVVSP3-VVIT STATIC-OMIT	3.95	1.5	2.6	.5	37	6.2	9.0	3.2	8
35	TVVDP1-VVIT DYNAMIC-RIGHT	.34	74.3	37.8	6.2	37	84.0	25.5	9.0	8
36	TVVDP2-VVIT DYNAMIC-WRONG	1.49	9.1	8.2	1.3	37	13.1	7.9	2.8	8
37	TVVDP3-VVIT DYNAMIC-OMIT	.47	45.5	38.6	6.3	37	31.9	25.7	9.1	8
38	TVVIR-VVIT RATER	1.63	15.7	6.9	1.1	37	12.2	3.3	1.1	8
39	TVVIS-VVIT SELF-RATING	1.68	14.2	5.7	.9	37	11.8	5.4	1.9	8
40	TVVIP-VVIT POST-RATING	1.57	5.8	10.2	1.7	37	.9	1.8	.4	8
41	TVVIT-VVIT TIME OF DAY	.24	10.0	1.4	.2	37	10.2	1.8	.4	8

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX
* = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

observed in the VT86-AJN students who flew the old flight syllabus (4). These findings are in contradistinction to the data reported for Advanced Squadron VT86-RIO (5) and Basic Squadron VT10 (new syllabus) (6) where the airsickness indices were generally higher for the attrite group.

COMPARISON OF STUDENT SUBPOPULATIONS BASED UPON AIRSICKNESS SENSITIVITY

In the first report (3) of the series it was emphasized that a long-term objective of this laboratory is to develop and validate an airsickness test battery to identify both susceptible and nonsusceptible aviation candidates. In this study, the inflight data derived from both the students and the instructors over the full course of the NFO training syllabus serve to quantitatively distinguish between those students who repeatedly suffer airsickness (high flight index scores) and those students who rarely experience airsickness (low flight index scores). Accordingly, separation of the students into susceptible and nonsusceptible groups based upon their actual flight performance provides some direct insight into the relative merit of the individual components of the prototype motion reactivity test battery given to the students prior to their beginning NFO flight training. In the paragraphs that follow, such an approach is pursued by comparing the flight and laboratory data produced by the most susceptible students (arbitrarily defined as those students with high scores falling into the upper decile of the entire population for a given airsickness measure) with those produced by the least susceptible students (arbitrarily defined as those students who never experienced airsickness during training).

As with the first report (3) of the series, the initial comparison to be made involves the weighted airsickness index data derived from the student questionnaire (variable 6). The nonsusceptible population was defined as those students who never reported experiencing airsickness during flight training in Squadron VT86-AJN. This corresponds to airsickness index scores of 0.0 for both the unweighted (variable 1) and weighted (variable 6) responses. The susceptible or airsick population was defined as those 10 percent of the student population who had a weighted airsickness index that equaled or exceeded the 90th centile (upper decile) reference established by the normalized cumulative frequency distribution for this particular index. The student-based distribution data presented in Figure C1-B indicate that at the 90th-centile point, the weighted index score was approximately 15.9. These distribution data also indicate that the nonairsick group included approximately 24 percent of the total squadron population for which airsickness index scores were determined.

With these criteria serving to define the airsick susceptible and nonairsick susceptible populations, a Kruskal-Wallis one-way analysis of variance was performed on each of the response variables, the results of which are tabulated in Table V. As indicated by the significance symbols entered adjacent to the $\underline{H}$ statistic, the airsickness-related flight indices (variables 1-3, 6-8, 11-13, and 16-18) were significantly different for the two populations, which, by definition, would occur as a result of the criterion selected to distinguish between the two populations. The medication index also shows a higher drug usage rate for the

Table V

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never experienced airsickness during flight training with students who had a relatively high incidence of airsickness. The nonairsick group, defined as those students with a weighted airsickness index (variable 6 from the student questionnaire) equal to 0.0, represented approximately 24 percent of the total study population. The airsick group, arbitrarily established as the most sensitive 10 percent of the students, was defined as those individuals with a weighted airsickness index equal to or greater than 15.9 which marked the upper decile for this measure.

NO.	RESPONSE VARIABLE DESCRIPTION	M STATISTIC	NONAIRSICK MEAN	S DEV.	S.ERR.	N	AIRSICK MEAN	S DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	27.82*	.0	.0	.0	21	41.6	7.9	2.6	9
2	S-VOMITING INDEX-UW	20.13*	.0	.0	.0	21	16.5	17.6	5.9	9
3	S-P.DEGRADATION INDEX-UW	21.72*	.2	1.0	.2	21	18.9	14.6	4.9	9
4	S-NERVOUSNESS INDEX-UW	6.95@	21.8	21.1	4.6	21	51.1	27.9	9.3	9
5	S-MEDICATION INDEX-UW	10.34*	.0	.0	.0	21	7.5	9.7	3.2	9
6	S-AIRSICKNESS INDEX-W	27.87*	.0	.0	.0	21	19.3	3.4	1.1	9
7	S-VOMITING INDEX-W	20.13*	.0	.0	.0	21	8.5	8.1	2.7	9
8	S-P.DEGRADATION INDEX-W	21.72*	.1	.3	.1	21	8.3	7.7	2.6	9
9	S-NERVOUSNESS INDEX-W	8.59@	7.5	7.4	1.6	21	20.9	10.1	3.4	9
10	S-MEDICATION INDEX-W	10.34@	.0	.0	.0	21	7.5	9.7	3.2	9
11	I-AIRSICKNESS INDEX-UW	23.86*	.0	.0	.0	21	18.7	15.6	5.2	9
12	I-VOMITING INDEX-UW	20.13*	0	.0	.0	21	16.3	18.2	6.1	9
13	I-P.DEGRADATION INDEX-UW	20.13*	.0	.0	.0	21	11.1	11.4	3.8	9
14	I-NERVOUSNESS INDEX-UW	.06	14.2	12.6	2.7	21	13.8	9.4	3.1	9
15	I-TURBULENCE INDEX-UW	4.44	22.6	14.6	3.2	21	36.5	13.1	4.4	9
16	I-AIRSICKNESS INDEX-W	23.85*	.0	.0	.0	21	10.0	8.6	2.9	9
17	I-VOMITING INDEX-W	20.13*	.0	.0	.0	21	7.7	8.6	2.	9
18	I-P.DEGRADATION INDEX-W	20.13*	.0	.0	.0	21	5.7	7.6	2.5	9
19	I-NERVOUSNESS INDEX-W	.01	5.5	5.4	1.2	21	4.6	3.1	1.0	9
20	I-TURBULENCE INDEX-W	5.34	9.7	6.4	1.4	21	17.3	7.6	2.5	9
21	ACADEMIC GRADES-BASIC	1.72	48.9	8.1	1.8	21	53.3	6.5	2.1	9
22	FLIGHT GRADES-BASIC	2.48	3.0	.0	.0	21	3.0	.0	.0	9
23	TMSQ1-MS HISTORY PART 1	1.71	6.8	11.4	3.8	9	11.2	7.3	3.7	4
24	TMSQ2-MS HISTORY PART 2	2.15	6.0	10.1	3.4	9	11.5	6.0	3.0	4
25	TMSQ3-MS HISTORY SUM	1.83	12.8	17.8	5.9	9	22.8	11.1	5.5	4
26	TSANX-STATE/ANX.QUEST.	7.35@	26.1	6.4	2.1	9	39.7	3.9	1.9	4
27	TTANX-TRAIT/ANX.QUEST.	.82	29.0	6.1	2.0	9	30.0	5.5	2.7	4
28	TBVDT-BVDT TIME OF DAY	.29	8.5	.6	.2	9	8.6	.5	.2	4
29	TBVDR-BVDT RATER	1.93	12.0	3.3	1.1	9	20.3	10.1	5.0	4
30	TBVDS-BVDT SELF-RATING	.73	11.3	5.3	1.8	9	14.2	8.1	4.0	4
31	TBVDP-BVDT POST-RATING	2.04	1.4	2.0	.9	9	12.7	21.0	10.5	4
32	TVVSP1-VVIT STATIC-RIGHT	.22	118.1	12.0	4.3	9	124.7	3.5	1.7	4
33	TVVSP2-VVIT STATIC-WRONG	.23	6.6	7.9	2.6	9	3.0	2.4	1.2	4
34	TVVSP3-VVIT STATIC-OMIT	.38	4.3	8.8	2.9	9	1.2	2.5	1.2	4
35	TVVDP1-VVIT DYNAMIC-RIGHT	.38	78.9	39.0	13.0	9	69.7	44.0	22.0	4
36	TVVDP2-VVIT DYNAMIC-WRONG	1.73	8.3	7.7	2.6	9	12.7	9.8	4.9	4
37	TVVDP3-VVIT DYNAMIC-OMIT	.00	41.0	40.1	13.4	9	46.5	52.3	26.1	4
38	TVVIR-VVIT RATER	.60	13.4	6.0	2.0	9	15.7	5.9	3.0	4
39	TVVIS-VVIT SELF-RATING	1.10	11.4	5.3	1.8	9	14.5	4.7	2.3	4
40	TVVIP-VVIT POST-RATING	.91	2.1	3.8	1.3	9	8.5	9.3	4.7	4
41	TVVIT-VVIT TIME OF DAY	.05	10.2	1.0	.3	9	10.1	.9	.5	4
42	ACADEMIC GRADES-ADVANCED	4.94	88.5	3.3	.0	15	92.0	2.9	1.1	7
43	FLIGHT GRADES-ADVANCED	2.53	3.0	.0	.0	15	3.0	.0	.0	7

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

airsick group. Differences were also observed for the student-based nervousness indices. In the case of the 19 motion reactivity test variables listed in Table V data were available for only four of the nine students comprising the airsick susceptible subpopulation, thus restricting the statistical interpretation of these results.

Although the primary intent of Table V is to provide some insight into which elements of the motion reactivity test battery provide the greatest potential to identify airsick susceptibles, the flight indices proper also provide a quantified description of the mean performance of the airsick group in this particular squadron. Accordingly, the flight indices in Table V allow comparisons to be made between the airsick susceptibles in this squadron and the susceptibles reported for other squadrons. For this reason, the comparative data which follow in Tables VI through IX are presented in an identical format to that used in previous reports (3-6). Because of the low N values associated with the motion reactivity test scores of the susceptible groups, these data will not be discussed.

Table VI is a similar comparison between students with a high (upper decile) weighted vomiting index (variable 7) and students who never reported vomiting on their training flights. This latter group, representing approximately 62 percent of the squadron population for which student-based weighted vomiting index scores were available, includes both those Table V students who were never airsick and thus never vomited and those students who were occasionally airsick but never reported vomiting. The upper decile, as derived from the Figure C2-B distribution data, for the susceptible student group was marked by a weighted vomiting index score of approximately 8.8.

In like manner, a Kruskal-Wallis one-way analysis of variance was applied to two student groups distinguished by the amount of inflight performance degradation experienced as a result of airsickness. As indicated in the heading of Table VII, the nonsusceptible student group was defined by those students who never reported the incidence of performance degradation. This group represented approximately 56 percent of the total study population. The susceptible group was defined by those students with a weighted performance degradation index (variable 8) that equaled or exceeded the upper decile score of approximately 7.0 as derived from the Figure C3-B distribution data.

Table VIII presents a corresponding analysis based upon the weighted nervousness index scores. The upper decile used to identify the highly nervous population was marked by a weighted nervousness index score (variable 9) of approximately 29.9 as derived from the Figure C4-B distribution data. The non-nervous group, i.e., the students who reported they never experienced nervousness during flight training, included only 17 percent of the total study population. In this analysis, significant differences between the two populations were found for several of the airsickness-related flight indices. The mean values were consistently higher for the nervous subpopulation.

Table VI

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported vomiting during flight training with students who reported a relatively high incidence of vomiting. The non-vomit group, defined as those students with a weighted vomit index (variable 7 from the student questionnaire data) equal to 0.0, represented approximately 62 percent of the study population. The vomit group was defined as those students with a weighted vomit index equal to or greater than 8.8 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONVOMIT MEAN	S.DEV.	S.ERR.	N	VOMIT MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	15.24*	8.3	9.8	1.3	53	30.2	16.2	5.4	9
2	S-VOMITING INDEX-UW	60.51*	.0	.0	.0	53	23.4	12.9	4.3	9
3	S-P.DEGRADATION INDEX-UW	13.75*	2.4	5.7	.8	53	17.2	16.4	5.5	9
4	S-NERVOUSNESS INDEX-UW	4.00	24.0	24.7	3.4	53	46.0	34.2	11.4	9
5	S-MEDICATION INDEX-UW	21.16*	.3	1.0	.2	53	9.5	11.0	3.7	9
6	S-AIRSICKNESS INDEX-W	18.51*	3.4	4.5	.6	53	14.5	6.6	2.2	9
7	S-VOMITING INDEX-W	60.51*	.0	.0	.0	53	14.1	4.2	1.4	9
8	S-P.DEGRADATION INDEX-W	14.86*	.9	2.1	.3	53	8.9	8.4	2.8	9
9	S-NERVOUSNESS INDEX-W	3.42	9.6	11.1	1.5	53	16.2	11.7	3.9	9
10	S-MEDICATION INDEX-W	21.16*	.3	1.0	.2	53	9.5	11.0	3.7	9
11	I-AIRSICKNESS INDEX-UW	20.22*	2.3	4.4	.6	53	21.0	14.0	4.9	9
12	I-VOMITING INDEX-UW	35.82*	.2	1.2	.2	53	21.2	16.3	5.4	9
13	I-P.DEGRADATION INDEX-UW	27.36*	.5	1.6	.2	53	14.6	11.3	3.8	9
14	I-NERVOUSNESS INDEX-UW	3.58	11.1	10.3	1.4	53	18.1	10.7	3.6	9
15	I-TURBULENCE INDEX-UW	3.57	25.2	12.5	1.7	53	38.0	21.6	7.2	9
16	I-AIRSICKNESS INDEX-W	21.06*	.8	1.5	.2	53	11.9	7.9	2.6	9
17	I-VOMITING INDEX-W	35.82*	.1	.7	.1	53	11.3	7.4	2.5	9
18	I-P.DEGRADATION INDEX-W	27.36*	.2	.5	.1	53	7.4	7.3	2.4	9
19	I-NERVOUSNESS INDEX-W	2.63	4.2	4.2	.6	53	6.0	3.6	1.2	9
20	I-TURBULENCE INDEX-W	5.20	11.0	5.7	.8	53	18.4	10.1	3.4	9
21	ACADEMIC GRADES-BASIC	1.00	49.0	7.8	1.1	53	52.6	7.8	2.6	9
22	FLIGHT GRADES-BASIC	3.00	3.0	.0	.0	53	3.0	.0	.0	9
23	TMSQ1-MS HISTORY PART 1	.11	7.5	8.7	1.6	29	4.3	4.5	2.6	3
24	TMSQ2-MS HISTORY PART 2	2.42	4.7	7.1	1.3	29	7.9	3.0	1.0	3
25	TMSQ3-MS HISTORY SUM	.96	12.1	12.5	2.3	29	12.2	1.7	1.0	3
26	TSANX-STATE/ANX.QUEST.	4.74	28.5	6.6	1.3	28	38.0	1.0	.6	3
27	TTANX-TRAIT/ANX.QUEST.	.59	29.6	6.9	1.3	28	26.7	2.3	1.3	3
28	TBVDT-BVDT TIME OF DAY	.13	8.8	1.0	.2	29	9.4	1.7	1.0	3
29	TBVDR-BVDT RATER	1.85	14.3	6.2	1.1	29	16.9	3.2	1.8	3
30	TBVDS-BVDT SELF-RATING	.71	12.3	5.9	1.1	29	14.7	5.8	3.3	3
31	TBVDP-BVDT POST-RATING	.03	2.9	8.2	1.5	29	1.0	1.0	.6	3
32	TVVSP1-VVIT STATIC-RIGHT	.01	122.1	10.8	2.0	29	125.0	3.5	2.0	3
33	TVVSP2-VVIT STATIC-WRONG	.24	4.4	7.0	1.3	29	4.0	3.5	2.0	3
34	TVVSP3-VVIT STATIC-OMIT	1.40	2.6	5.6	1.0	29	.0	.0	.0	3
35	TVVDP1-VVIT DYNAMIC-RIGHT	.07	75.0	35.4	6.6	29	62.7	53.0	30.6	3
36	TVVDP2-VVIT DYNAMIC-WRONG	.15	9.1	8.7	1.6	29	8.3	3.5	2.0	3
37	TVVDP3-VVIT DYNAMIC-OMIT	.18	44.6	36.1	6.7	29	58.0	54.7	31.6	3
38	TVVIR-VVIT RATER	.83	14.6	6.1	1.1	29	14.7	5.1	2.9	3
39	TVVIS-VVIT SELF-RATING	.89	12.9	5.2	1.0	29	11.7	2.3	1.3	3
40	TVVIP-VVIT POST-RATING	.00	3.7	6.6	1.2	29	5.3	8.4	4.8	3
41	TVVIT-VVIT TIME OF DAY	.55	10.2	1.5	.3	29	9.5	1.3	.8	3
42	ACADEMIC GRADES-ADVANCED	.47	98.1	3.8	.6	45	91.5	4.7	1.6	9
43	FLIGHT GRADES-ADVANCED	.00	3.0	.0	.0	45	3.0	.1	.0	9

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table VII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported experiencing performance degradation due to airsickness with students who reported a relatively high incidence of performance degradation. The non-affected group, defined as those students with a weighted performance degradation index (variable 8 from the student questionnaire data) equal to 0.0, represented approximately 56 percent of the study population. The affected group was defined as those students with a weighted performance degradation index equal to or greater than 7.0 which marked the upper decile for this measure.

NO.	RESPONSE VARIABLE DESCRIPTION	H STATISTIC	NO PER. DEGRADATION MEAN	S.DEV.	S.ERR.	N	HIGH PER. DEGRADATION MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	14.62*	7.6	10.4	1.5	48	28.2	15.5	5.5	8
2	S-VOMITING INDEX-UW	22.05*	2.2	7.8	1.1	48	17.7	10.9	3.9	8
3	S-P.DEGRADATION INDEX-UW	54.57*	.0	.0	.0	48	27.4	9.8	3.5	8
4	S-NERVOUSNESS INDEX-UW	4.51	23.8	26.9	3.9	48	42.8	29.6	10.4	8
5	S-MEDICATION INDEX-UW	16.10*	.4	1.9	.3	48	10.2	11.6	4.1	8
6	S-AIRSICKNESS INDEX-W	10.00*	2.0	3.8	.5	48	15.7	6.9	2.4	8
7	S-VOMITING INDEX-W	23.22*	1.0	3.1	.4	48	11.7	6.9	2.4	8
8	S-P.DEGRADATION INDEX-W	54.57*	.0	.0	.0	48	13.3	5.4	1.9	8
9	S-NERVOUSNESS INDEX-W	5.74	8.2	9.6	1.4	48	17.6	11.3	4.0	8
10	S-MEDICATION INDEX-W	16.10*	.4	1.9	.3	48	10.2	11.6	4.1	8
11	I-AIRSICKNESS INDEX-UW	10.00@	3.4	8.1	1.2	48	16.2	11.9	4.2	8
12	I-VOMITING INDEX-UW	17.19*	2.0	7.5	1.1	48	17.3	13.1	4.6	8
13	I-P.DEGRADATION INDEX-UW	21.70*	.7	2.1	.3	48	14.9	11.8	4.2	8
14	I-NERVOUSNESS INDEX-UW	7.00@	11.0	10.5	1.5	48	20.3	7.3	2.6	8
15	I-TURBULENCE INDEX-UW	2.97	24.3	12.4	1.8	48	33.6	17.9	6.3	8
16	I-AIRSICKNESS INDEX-W	10.51@	1.2	3.1	.5	48	10.3	8.3	2.9	8
17	I-VOMITING INDEX-W	17.72*	.7	2.6	.4	48	10.3	7.7	2.7	8
18	I-P.DEGRADATION INDEX-W	22.01*	.2	.7	.1	48	8.3	7.4	2.6	8
19	I-NERVOUSNESS INDEX-W	6.11	4.1	4.2	.6	48	6.8	2.4	.9	8
20	I-TURBULENCE INDEX-W	3.05	10.6	5.9	.8	48	16.0	9.2	3.3	8
21	ACADEMIC GRADES-BASIC	.15	49.8	7.8	1.1	48	49.2	7.5	2.7	8
22	FLIGHT GRADES-BASIC	.31	3.0	.0	.0	48	3.0	.0	.0	8
23	TMSQ1-MS HISTORY PART 1	1.46	7.0	9.1	2.0	20	16.2	14.8	7.4	4
24	TMSQ2-MS HISTORY PART 2	5.77	4.0	7.1	1.6	20	11.9	5.8	2.9	4
25	TMSQ3-MS HISTORY SUM	4.17	11.0	13.1	2.9	20	28.0	19.7	9.8	4
26	TSANX-STATE/ANX.QUEST.	8.11@	26.3	5.3	1.2	19	39.2	3.3	1.7	4
27	TTANX-TRAIT/ANX.QUEST.	.06	27.7	5.3	1.2	19	28.7	5.7	2.9	4
28	TBVDT-BVDT TIME OF DAY	.01	9.0	1.1	.3	20	9.2	1.5	.7	4
29	TBVDR-BVDT RATER	7.58@	13.0	3.8	.9	20	20.7	3.3	1.6	4
30	TBVDS-BVDT SELF-RATING	1.46	12.2	6.3	1.4	20	16.7	8.5	4.3	4
31	TBVDP-BVDT POST-RATING	2.00	1.4	2.3	.5	20	8.5	12.6	6.3	4
32	TVVSP1-VVIT STATIC-RIGHT	.13	120.7	12.2	2.7	20	124.0	3.5	1.7	4
33	TVVSP2-VVIT STATIC-WRONG	.01	5.7	7.9	1.8	20	3.0	2.4	1.2	4
34	TVVSP3-VVIT STATIC-OMIT	.60	2.6	6.5	1.4	20	2.0	2.4	1.2	4
35	TVVDP1-VVIT DYNAMIC-RIGHT	.10	73.2	38.2	8.5	20	83.2	49.9	25.0	4
36	TVVDP2-VVIT DYNAMIC-WRONG	.73	8.5	8.9	2.0	20	9.0	6.2	3.1	4
37	TVVDP3-VVIT DYNAMIC-OMIT	.02	47.3	38.7	8.6	20	36.7	52.3	26.1	4
38	TVVIR-VVIT RATER	.73	15.0	7.4	1.7	20	17.0	3.7	1.8	4
39	TVVIS-VVIT SELF-RATING	.12	13.4	5.8	1.3	20	15.0	6.9	3.5	4
40	TVVIP-VVIT POST-RATING	.36	3.0	7.1	1.6	20	5.7	6.9	3.4	4
41	TVVIT-VVIT TIME OF DAY	2.53	10.1	1.3	.3	20	9.0	.5	.2	4
42	ACADEMIC GRADES-ADVANCED	.16	90.2	4.0	.6	41	91.4	4.3	1.6	7
43	FLIGHT GRADES-ADVANCED	.99	3.0	.0	.0	41	3.1	.0	.0	7

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table VIII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported experiencing nervousness before or during a flight with students who reported a relatively high incidence of nervousness. The non-nervous group, defined as those students with a weighted nervousness index (variable 9 from the student questionnaire data) equal to 0.0, represented approximately 17 percent of the study population. The nervous group was defined as those students with a weighted nervousness index equal to or greater than 29.9 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONNERVOUS MEAN	S.DEV.	S.ERR.	N	NERVOUS MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	6.87	7.1	10.6	2.7	15	21.9	14.6	4.9	9
2	S-VOMITING INDEX-UW	9.95*	.4	1.7	.4	15	9.0	10.9	3.6	9
3	S-P.DEGRADATION INDEX-UW	8.17*	1.3	5.2	1.3	15	9.0	11.2	3.7	9
4	S-NERVOUSNESS INDEX-UW	21.43*	.0	.0	.0	15	89.0	7.2	2.4	9
5	S-MEDICATION INDEX-UW	5.45	.0	.0	.0	15	5.7	9.0	3.3	9
6	S-AIRSICKNESS INDEX-W	7.98*	2.6	3.6	.9	15	10.3	7.6	2.5	9
7	S-VOMITING INDEX-W	8.68*	.4	1.7	.4	15	5.4	7.1	2.4	9
8	S-P.DEGRADATION INDEX-W	8.82*	.4	1.7	.4	15	4.7	6.0	2.0	9
9	S-NERVOUSNESS INDEX-W	21.41*	.0	.0	.0	15	35.6	5.0	1.9	9
10	S-MEDICATION INDEX-W	5.45	.0	.0	.0	15	5.7	9.0	3.3	9
11	I-AIRSICKNESS INDEX-UW	5.25	3.2	5.4	1.4	15	11.9	11.1	3.7	9
12	I-VOMITING INDEX-UW	4.90	.9	2.3	.6	15	7.0	11.1	3.7	9
13	I-P.DEGRADATION INDEX-UW	1.48	.9	2.3	.6	15	4.4	8.7	2.9	9
14	I-NERVOUSNESS INDEX-UW	5.62	7.2	6.5	1.7	15	22.5	19.2	6.4	9
15	I-TURBULENCE INDEX-UW	2.00	23.4	15.4	4.0	15	33.0	11.1	3.7	9
16	I-AIRSICKNESS INDEX-W	6.78*	1.1	1.8	.5	15	5.9	7.1	2.4	9
17	I-VOMITING INDEX-W	4.17	.6	1.5	.4	15	3.6	6.5	2.2	9
18	I-P.DEGRADATION INDEX-W	1.48	.3	.8	.2	15	2.3	4.8	1.6	9
19	I-NERVOUSNESS INDEX-W	5.34	2.5	2.1	.6	15	8.4	7.2	2.4	9
20	I-TURBULENCE INDEX-W	3.00	9.8	6.4	1.6	15	15.2	6.7	2.2	9
21	ACADEMIC GRADES-BASIC	.02	48.5	9.0	2.3	15	48.5	10.9	3.6	9
22	FLIGHT GRADES-BASIC	.43	3.0	.0	.0	15	3.0	.0	.0	9
23	TMSQ1-MS HISTORY:PART 1	.00	3.9	5.6	3.9	2	7.5	2.1	1.5	2
24	TMSQ2-MS HISTORY:PART 2	1.00	.0	.0	.0	2	2.2	3.2	2.2	2
25	TMSQ3-MS HISTORY:SUM	.60	3.9	5.6	3.9	2	9.7	5.3	3.7	2
26	TSANX-STATE/ANX QUEST.	2.67	24.0	1.4	1.0	2	37.0	.0	.0	2
27	TTANX-TRAIT/ANX.QUEST.	.60	23.5	3.5	2.5	2	31.5	10.6	7.5	2
28	TBVDT-BVDT TIME OF DAY	.00	9.0	1.5	1.0	2	8.6	.4	.3	2
29	TBVDR-BVDT RATER	.60	14.9	2.6	1.8	2	17.9	3.0	2.1	2
30	TBVDS-BVDT SELF-RATING	2.40	22.0	5.7	4.0	2	10.0	2.8	2.0	2
31	TBVDP-BVDT POST-RATING	1.00	.0	.0	.0	2	.5	.7	.5	2
32	TVVSP1-VVIT STATIC-RIGHT	.60	125.0	5.7	4.0	2	121.5	2.1	1.5	2
33	TVVSP2-VVIT STATIC-WRONG	.00	4.0	5.7	4.0	2	6.0	.0	.0	2
34	TVVSP3-VVIT STATIC-OMIT	1.00	.0	.0	.0	2	1.5	2.1	1.5	2
35	TVVDP1-VVIT DYNAMIC-RIGHT	.00	47.0	.0	.0	2	61.5	74.2	52.5	2
36	TVVDP2-VVIT DYNAMIC-WRONG	2.40	18.5	13.4	9.5	2	5.5	.7	.5	2
37	TVVDP3-VVIT DYNAMIC-OMIT	.00	63.5	13.4	9.5	2	62.0	75.0	53.0	2
38	TVVIR-VVIT RATER	.60	16.0	4.9	3.5	2	17.2	4.6	3.2	2
39	TVVIS-VVIT SELF-RATING	2.40	18.5	4.9	3.5	2	10.5	3.5	2.5	2
40	TVVIP-VVIT POST-RATING	2.40	.5	.7	.5	2	10.5	6.4	4.5	2
41	TVVIT-VVIT TIME OF DAY	.00	9.7	2.6	1.8	2	9.2	.0	.0	2
42	ACADEMIC GRADES-ADVANCED	.17	89.0	4.5	1.3	11	89.6	5.3	1.8	9
43	FLIGHT GRADES-ADVANCED	2.00	3.0	.0	.0	11	3.0	.0	.0	9

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX
* = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

In Tables V through VIII, the classification criteria used to define the susceptible and nonsusceptible populations were based upon flight indices derived from the student judgments of their own experiences. It should be recognized that the classification criteria could also be derived from the instructor judgments of student flight performance. This is demonstrated by Table IX which is identical to Table V, with the exception that the airsick and nonairsick populations are defined by the instructor-based weighted airsickness index (variable 16) instead of the corresponding student-based index (variable 6). With this instructor-based airsickness index, the highly susceptible (upper decile) population was defined as those students who had a weighted airsickness index equal to or greater than 9.4 as derived from the Figure C1-D distribution data. The low susceptibility group for the instructor-based population subdivision (students judged by the instructors to have never experienced airsickness during training) included approximately 48 percent of the squadron population. It should be noted that the nonairsick student group defined by the students proper included only 24 percent of the population, again reflecting the general underestimation of airsickness by the instructors.

FLIGHT AND LABORATORY DATA CORRELATIONS

As with the previous reports in the longitudinal study, a Spearman rank correlation analysis corrected for tied scores was applied to the flight and laboratory test score data to gain some insight into relationships that may exist among the different response variables. The results of this analysis are presented in matrix form in Table X, with the total number of data pairs associated with a given correlation coefficient within this matrix tabulated in similar form in Table XI. Table X also lists the unity value correlation of a variable with itself so as to establish the total number of observations available for analysis. To establish the statistical significance of the rank correlation coefficients, a t statistic was calculated for each relationship and a standard two-tailed student t-test table evaluation performed. Those correlations which the t-test evaluation identified as being statistically significant at the .01 and .001 levels or greater are identified accordingly in Table X. To facilitate the general interpretation of the relative strength of relationship described by the magnitude of the correlations, the definitions of Guilford (ref. 1, p. 145) as described below will be arbitrarily adopted for discussion:

Less than .20	Slight; almost negligible relationship
.20-.40	Low correlation; definite but small relationship
.40-.70	Moderate correlation; substantial relationship
.70-.90	High correlations; marked relationship
.90-1.00	Very high correlations; very dependable relationship.

In the discussion that follows, reference generally will be made to only

Table IX

Results of a Kruskal-Wallis one-way analysis of variance comparison of students identified by the flight instructors as never being airsick with students identified by the instructors as having a relatively high incidence of airsickness (see Table V for an equivalent comparison based upon student judgments). The non-airsick group, defined as those students with a weighted airsickness index (variable 16 from the instructor questionnaire data) equal to 0.0, represented approximately 48 percent of the total study population. The airsick group was defined as those students with a weighted airsickness index equal to or greater than 9.4 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONAIRSICK MEAN	S.DEV.	S.ERR.	N	AIRSICK MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	21.62*	6.1	7.8	1.2	41	30.9	14.3	4.5	10
2	S-VOMITING INDEX-UW	39.55*	.5	2.1	.3	41	21.8	13.3	4.2	10
3	S-P.DEGRADATION INDEX-UW	16.91*	3.1	7.4	1.2	41	17.3	14.4	4.6	10
4	S-NERVOUSNESS INDEX-UW	1.71	24.6	23.0	3.6	41	37.1	28.9	9.1	10
5	S-MEDICATION INDEX-UW	10.630	1.2	5.2	.8	41	6.4	8.0	2.5	10
6	S-AIRSICKNESS INDEX-W	21.05*	2.7	4.0	.6	41	14.1	6.6	2.1	10
7	S-VOMITING INDEX-W	30.39*	.4	1.6	.3	41	12.2	6.1	1.9	10
8	S-P.DEGRADATION INDEX-W	17.03*	1.3	3.0	.5	41	8.0	7.8	2.5	10
9	S-NERVOUSNESS INDEX-W	1.60	9.6	10.3	1.6	41	13.5	10.3	3.3	10
10	S-MEDICATION INDEX-W	10.630	1.2	5.2	.8	41	6.4	8.0	2.5	10
11	I-AIRSICKNESS INDEX-UW	49.23*	.0	.0	.0	41	25.9	10.7	3.4	10
12	I-VOMITING INDEX-UW	45.69*	.1	.9	.1	41	23.1	12.9	4.1	10
13	I-P.DEGRADATION INDEX-UW	45.70*	.1	.9	.1	41	17.9	7.8	2.5	10
14	I-NERVOUSNESS INDEX-UW	3.20	12.1	10.6	1.7	41	18.0	9.2	2.9	10
15	I-TURBULENCE INDEX-UW	7.580	23.7	14.3	2.2	41	41.2	14.7	4.6	10
16	I-AIRSICKNESS INDEX-W	49.25*	.0	.0	.0	41	13.0	5.1	1.6	10
17	I-VOMITING INDEX-W	45.69*	.0	.3	.0	41	12.2	5.5	1.7	10
18	I-P.DEGRADATION INDEX-W	45.69*	.0	.3	.0	41	8.5	6.0	1.9	10
19	I-NERVOUSNESS INDEX-W	1.94	4.6	4.3	.7	41	6.0	3.1	1.0	10
20	I-TURBULENCE INDEX-W	10.420	10.1	6.4	1.0	41	15.8	6.8	2.2	10
21	ACADEMIC GRADES-BASIC	.90	49.0	7.2	1.1	41	53.3	5.3	1.7	10
22	FLIGHT GRADES-BASIC	2.48	3.0	.0	.0	41	3.0	.0	.0	10
23	TMSQ1-MS HISTORY,PART 1	.01	8.1	9.8	2.1	21	9.3	14.2	6.3	5
24	TMSQ2-MS HISTORY,PART 2	5.61	4.7	7.4	1.6	21	13.5	8.4	3.7	5
25	TMSQ3-MS HISTORY SUM	2.01	12.8	13.9	3.0	21	22.8	17.2	7.7	5
26	TSANX-STATE/ANX QUEST	7.07@	28.0	6.3	1.4	20	36.2	3.6	1.6	5
27	TTANX-TRAIT/ANX QUEST	2.67	31.1	7.3	1.6	20	26.2	1.8	.8	5
28	TBVDT-BVDT TIME OF DAY	.04	9.0	1.1	.2	21	9.2	1.3	.6	5
29	TBVDR-BVDT RATER	3.45	12.8	3.9	.9	21	17.3	5.5	2.4	5
30	TBVDS-BVDT SELF-RATING	4.11	12.8	5.3	1.1	21	18.4	7.1	3.2	5
31	TBVDP-BVDT POST-RATING	2.61	1.6	2.4	.5	21	8.0	11.3	5.1	5
32	TVVSP1-VVIT STATIC-RIGHT	.29	121.1	11.9	2.6	21	123.2	3.9	1.7	5
33	TVVSP2-VVIT STATIC-WRONG	.33	5.0	7.3	1.7	21	4.0	2.5	1.1	5
34	TVVSP3-VVIT STATIC-OMIT	.04	2.8	6.3	1.4	21	1.8	2.7	1.2	5
35	TVVDP1-VVIT DYNAMIC-RIGHT	.38	79.3	36.2	7.9	21	65.0	47.7	21.3	5
36	TVVDP2-VVIT DYNAMIC-WRONG	.21	9.4	8.7	1.9	21	6.0	4.4	2.0	5
37	TVVDP3-VVIT DYNAMIC-OMIT	.77	40.3	37.1	8.1	21	58.0	49.6	22.2	5
38	TVVIR-VVIT RATER	1.23	13.8	5.4	1.2	21	16.9	4.8	2.1	5
39	TVVIS-VVIT SELF-RATING	2.35	11.6	4.9	1.1	21	16.2	6.6	2.9	5
40	TVVIP-VVIT POST-RATING	1.52	3.7	6.9	1.5	21	11.0	14.8	6.6	5
41	TVVIT-VVIT TIME OF DAY	1.37	10.3	1.2	.3	21	9.6	1.0	.5	5
42	ACADEMIC GRADES-ADVANCED	.24	89.8	4.1	.7	34	90.9	4.1	1.3	10
43	FLIGHT GRADES-ADVANCED	.55	3.0	.0	.0	34	3.0	.1	.0	10

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

RESPONSE VARIABLE NO.	DESCRIPTION	1	2	3	4	5	6	7	8
1	S-AIRSICKNESS INDEX-UW	1.00							
2	S-VOMITING INDEX-UW	.57*	1.00						
3	S-P.DEGRADATION INDEX-UW	.62*	.57*	1.00					
4	S-NERVOUSNESS INDEX-UW	.29@	.31@	.35*	1.00				
5	S-MEDICATION INDEX-UW	.34@	.47*	.42*	.23	1.00			
6	S-AIRSICKNESS INDEX-W	.98*	.60*	.66*	.32@	.38*	1.00		
7	S-VOMITING INDEX-W	.58*	.99*	.57*	.31@	.51*	.62*	1.00	
8	S-P.DEGRADATION INDEX-W	.61*	.58*	.99*	.36*	.43*	.66*	.59*	1.00
9	S-NERVOUSNESS INDEX-W	.30@	.28@	.37*	.99*	.22	.33@	.28@	.39*
10	S-MEDICATION INDEX-W	.34@	.47*	.42*	.23	1.00	.38*	.51*	.43*
11	I-AIRSICKNESS INDEX-UW	.69*	.74*	.51*	.21	.36*	.69*	.72*	.51*
12	I-VOMITING INDEX-UW	.53*	.87*	.52*	.24	.40*	.55*	.85*	.52*
13	I-P.DEGRADATION INDEX-UW	.58*	.71*	.61*	.15	.32@	.60*	.71*	.60*
14	I-NERVOUSNESS INDEX-UW	.06	.22	.22	.39*	.18	.07	.22	.24
15	I-TURBULENCE INDEX-UW	.25	.22	.27@	.28@	.08	.26	.21	.28@
16	I-AIRSICKNESS INDEX-W	.69*	.76*	.52*	.23	.37*	.69*	.75*	.52*
17	I-VOMITING INDEX-W	.52*	.85*	.52*	.23	.42*	.56*	.85*	.52*
18	I-P.DEGRADATION INDEX-W	.58*	.71*	.61*	.16	.33@	.61*	.71*	.61*
19	I-NERVOUSNESS INDEX-W	.07	.18	.22	.40*	.17	.08	.18	.24
20	I-TURBULENCE INDEX-W	.26	.26	.35*	.22	.09	.25	.25	.36*
21	ACADEMIC GRADES-BASIC	.20	.14	.03	-.01	-.15	.17	.14	.03
22	FLIGHT GRADES-BASIC	.26	.19	.12	-.23	-.01	.23	.18	.12
23	TMSQ1-MS HISTORY: PART 1	.27	.02	.14	.22	-.06	.29	.01	.13
24	TMSQ2-MS HISTORY: PART 2	.35	.26	.35	.24	.32	.34	.27	.35
25	TMSQ3-MS HISTORY: SUM	.46@	.21	.34	.30	.23	.45@	.21	.33
26	TSANX-STATE/ANX.QUEST.	.53*	.56*	.64*	.20	.27	.54*	.55*	.63*
27	TTANX-TRAIT/ANX.QUEST.	.06	-.03	.18	.39	-.22	.08	-.04	.17
28	TBVDT-BVDT TIME OF DAY	.17	.05	-.04	-.15	.07	.16	.06	-.04
29	TBVDR-BVDT RATER	.30	.25	.28	.20	-.02	.31	.24	.27
30	TBVDS-BVDT SELF-RATING	.36	.38	.29	.12	-.04	.35	.38	.29
31	TBVDP-BVDT POST-RATING	.41@	.29	.26	.25	-.08	.38	.28	.24
32	TVVSP1-VVIT STATIC-RIGHT	.16	-.23	-.07	-.08	-.11	.18	-.22	-.06
33	TVVSP2-VVIT STATIC-WRONG	-.18	.28	-.02	.13	.19	-.20	.27	-.03
34	TVVSP3-VVIT STATIC-OMIT	-.06	.01	.18	-.09	-.20	-.08	.01	.17
35	TVVDP1-VVIT DYNAMIC-RIGHT	-.06	-.09	.05	.13	.05	-.06	-.08	.06
36	TVVDP2-VVIT DYNAMIC-WRONG	.02	.11	.15	-.03	.02	.03	.11	.15
37	TVVDP3-VVIT DYNAMIC-OMIT	.04	.08	-.05	-.12	-.06	.04	.07	-.06
38	TVVIR-VVIT RATER	.25	.19	.14	.16	-.07	.24	.18	.12
39	TVVIS-VVIT SELF-RATING	.37	.33	.11	-.02	.02	.35	.33	.10
40	TVVIP-VVIT POST-RATING	.30	.23	.19	.31	-.01	.25	.22	.18
41	TVVIT-VVIT TIME OF DAY	.09	-.18	-.13	.10	-.22	.04	-.18	-.13
42	ACADEMIC GRADES-ADVANCED	.19	.03	-.00	-.05	-.09	.20	.03	-.01
43	FLIGHT GRADES-ADVANCED	.22	.11	.01	-.18	-.08	.22	.09	.02

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table X

Correlation matrix for the Squadron VT86-AJN flight and laboratory data based upon the Spearman rank correlation

												RESPONSE VARIABLE						
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
00																		
59*	1.00																	
20*	.39*	1.00																
51*	.43*	.22	1.00															
72*	.51*	.20	.36*	1.00														
85*	.52*	.21	.40*	.70*	1.00													
71*	.60*	.14	.32*	.74*	.81*	1.00												
22	.24	.39*	.10	.19	.21	.10	1.00											
21	.20*	.30*	.00	.20*	.36*	.34*	.27*	1.00										
75*	.52*	.22	.37*	.99*	.00*	.74*	.10	.29*	1.00									
85*	.52*	.21	.42*	.70*	.99*	.02*	.21	.36*	.00*	1.00								
71*	.61*	.15	.33*	.74*	.01*	1.00*	.10	.34*	.74*	.03*	1.00							
10	.24	.41*	.17	.16	.19	.16	.90*	.27*	.14	.19	.17	1.00						
25	.36*	.23	.09	.34*	.39*	.41*	.20*	.90*	.35*	.39*	.41*	.20*	1.00					
14	.03	-.03	-.15	.10	.10	.17	.06	.14	.09	.20	.17	.06	.16	1.00				
10	.12	-.23	-.01	.12	.20	.19	-.09	.17	.12	.19	.19	-.09	.21	.42*	1.00			
01	.13	.26	-.06	.05	.16	.15	-.04	.10	.06	.12	.16	.03	-.06	.14	.07	1.00		
27	.35	.25	.32	.25	.26	.24	.22	.04	.25	.27	.24	.27	.11	.16	-.01	.17	1.00	
21	.33	.32	.23	.24	.31	.30	.09	.07	.24	.29	.30	.17	.02	.22	.05	.73*	.76*	1.00
55*	.63*	.30	.27	.53*	.35	.39	.06	.05	.53*	.35	.39	.05	.03	.11	.12	.27	.30	.34
04	.17	.42*	-.22	-.24	-.11	-.10	-.15	-.06	-.23	-.11	-.10	-.07	-.15	.13	-.19	.15	.16	.19
06	-.04	-.14	.07	-.07	-.06	-.02	-.15	-.22	-.06	-.05	-.02	-.19	-.16	-.04	.10	-.23	-.19	-.19
24	.27	.21	-.02	.30	.21	.20	.25	.09	.30	.21	.21	.16	-.03	.20	.15	.44*	.01	.20
30	.29	.10	-.04	.30	.32	.34	-.12	.11	.37	.32	.34	-.14	.03	.00	-.02	.13	.03	.10
20	.24	.24	-.00	.32	.15	.19	.01	-.06	.31	.13	.19	-.01	-.14	.06	-.16	.37	.23	.30
22	-.06	-.00	-.11	-.00	-.05	-.00	-.14	.11	-.07	-.02	-.07	-.05	.00	.33	.20	.25	.19	.33
27	-.03	.09	.19	.11	.10	.09	.13	-.13	.10	.00	.00	.06	-.07	-.25	-.20	-.22	-.15	-.20
01	.17	-.03	-.20	-.02	-.12	.01	-.10	-.06	-.02	-.14	.01	-.16	-.14	-.30	-.16	-.31	-.23	-.37
00	.06	.10	.05	-.17	-.20	-.17	-.06	-.11	-.16	-.10	-.15	-.05	.04	-.11	-.19	.05	.09	.00
11	.15	.01	.02	.01	.06	.06	-.05	-.02	.02	.07	.06	-.00	-.00	-.34	.02	-.20	-.25	-.40*
07	-.06	-.10	-.06	.10	.20	.10	.10	.17	.17	.10	.16	.09	.01	.22	.20	.02	-.06	.06
10	.12	.14	-.07	.20	.24	.19	-.02	.10	.20	.23	.19	-.06	-.00	.30	.10	.40*	-.14	.20
33	.10	-.06	.02	.49*	.34	.35	-.29	-.10	.49*	.34	.35	-.32	-.20	-.06	.01	.25	.03	.19
22	.10	.30	-.01	.26	.00	.10	.03	-.03	.25	.07	.09	-.01	-.11	.11	-.04	.29	.16	.34
10	-.13	.09	-.22	-.10	-.32	-.32	.06	-.13	-.19	-.31	-.33	.03	-.01	-.05	-.09	-.21	-.12	-.13
03	-.01	-.04	-.09	.05	.10	.19	-.23	.11	.07	.12	.19	-.20	.12	.40*	.25	-.02	-.03	-.06
09	.02	-.20	-.00	.05	.13	.10	-.22	.04	.05	.12	.11	-.19	.07	.53*	.54*	.15	.09	.16

E INDEX
INDEX

correlation coefficient adjusted for tied ranks.

	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
6	1.00																		
0	.34	1.00																	
6	.19	.44	1.00																
0	-.19	-.19	-.08	1.00															
1	.28	.52*	.05	-.13	1.00														
3	.10	.58*	.34	-.09	.49*	1.00													
3	.38	.63*	.27	-.15	.52*	.65*	1.00												
0	.33	-.10	.07	.07	-.01	-.10	-.19	1.00											
5	-.28	.13	.05	-.08	.00	.10	.17	-.95*	1.00										
3	-.37	.01	.03	.05	-.04	.14	.20	-.72*	.51*	1.00									
0	.00	.06	.27	-.15	-.06	.05	-.11	.16	-.14	-.00	1.00								
5	-.40	-.09	-.10	-.01	-.12	-.06	-.23	-.46	.42	.39	-.04	1.00							
5	.06	-.01	-.25	.10	.13	.01	.17	-.04	.02	-.00	-.96*	-.10	1.00						
4	.20	.39	.05	-.03	.67*	.50*	.53*	-.01	-.02	-.01	-.42	-.28	.52*	1.00					
2	.19	.36	.13	.01	.37	.61*	.56*	-.22	.20	.14	-.20	-.06	.27	.61*	1.00				
5	.34	.37	.24	.01	.55*	.30	.47	-.11	.08	.06	-.23	-.10	.27	.64*	.46	1.00			
2	-.13	-.13	.12	.52*	-.01	.07	-.00	.22	-.24	-.10	.02	-.13	-.03	-.01	-.05	.19	1.00		
2	-.06	-.24	-.14	.10	-.06	-.10	-.37	.25	-.27	-.13	.01	.07	.00	-.00	-.16	-.10	-.26	1.00	
0	.16	-.01	-.11	.24	-.10	-.03	-.29	.50	-.42	-.42	-.10	-.29	.22	.15	.00	-.27	-.07	.31	1.00

Matrix indica

NO.	RESPONSE VARIABLE DESCRIPTION	1	2	3	4	5	6	7	8	9
1	S-AIRSICKNESS INDEX-UW	86								
2	S-VOMITING INDEX-UW	86	86							
3	S-P.DEGRADATION INDEX-UW	86	86	86						
4	S-NERVOUSNESS INDEX-UW	86	86	86	86					
5	S-MEDICATION INDEX-UW	86	86	86	86	86				
6	S-AIRSICKNESS INDEX-W	86	86	86	86	86	86			
7	S-VOMITING INDEX-W	86	86	86	86	86	86	86		
8	S-P.DEGRADATION INDEX-W	86	86	86	86	86	86	86	86	
9	S-NERVOUSNESS INDEX-W	86	86	86	86	86	86	86	86	86
10	S-MEDICATION INDEX-W	86	86	86	86	86	86	86	86	86
11	I-AIRSICKNESS INDEX-UW	86	86	86	86	86	86	86	86	86
12	I-VOMITING INDEX-UW	86	86	86	86	86	86	86	86	86
13	I-P.DEGRADATION INDEX-UW	86	86	86	86	86	86	86	86	86
14	I-NERVOUSNESS INDEX-UW	86	86	86	86	86	86	86	86	86
15	I-TURBULENCE INDEX-UW	86	86	86	86	86	86	86	86	86
16	I-AIRSICKNESS INDEX-W	86	86	86	86	86	86	86	86	86
17	I-VOMITING INDEX-W	86	86	86	86	86	86	86	86	86
18	I-P.DEGRADATION INDEX-W	86	86	86	86	86	86	86	86	86
19	I-NERVOUSNESS INDEX-W	86	86	86	86	86	86	86	86	86
20	I-TURBULENCE INDEX-W	86	86	86	86	86	86	86	86	86
21	ACADEMIC GRADES-BASIC	86	86	86	86	86	86	86	86	86
22	FLIGHT GRADES-BASIC	86	86	86	86	86	86	86	86	86
23	TMSQ1-MS HISTORY, PART 1	39	39	39	39	39	39	39	39	39
24	TMSQ2-MS HISTORY, PART 2	39	39	39	39	39	39	39	39	39
25	TMSQ3-MS HISTORY, SUM	39	39	39	39	39	39	39	39	39
26	TSANX-STATE/ANX.QUEST.	38	38	38	38	38	38	38	38	38
27	TTANX-TRAIT/ANX.QUEST.	38	38	38	38	38	38	38	38	38
28	TBVDT-BVDT TIME OF DAY	39	39	39	39	39	39	39	39	39
29	TBVDR-BVDT RATER	39	39	39	39	39	39	39	39	39
30	TBVDS-BVDT SELF-RATING	39	39	39	39	39	39	39	39	39
31	TBVDP-BVDT POST-RATING	38	38	38	38	38	38	38	38	38
32	TVVSP1-VVIT STATIC-RIGHT	39	39	39	39	39	39	39	39	39
33	TVVSP2-VVIT STATIC-WRONG	39	39	39	39	39	39	39	39	39
34	TVVSP3-VVIT STATIC-OMIT	39	39	39	39	39	39	39	39	39
35	TVVDP1-VVIT DYNAMIC-RIGHT	39	39	39	39	39	39	39	39	39
36	TVVDP2-VVIT DYNAMIC-WRONG	39	39	39	39	39	39	39	39	39
37	TVVDP3-VVIT DYNAMIC-OMIT	39	39	39	39	39	39	39	39	39
38	TVVIR-VVIT RATER	39	39	39	39	39	39	39	39	39
39	TVVIS-VVIT SELF-RATING	39	39	39	39	39	39	39	39	39
40	TVVIP-VVIT POST-RATING	39	39	39	39	39	39	39	39	39
41	TVVIT-VVIT TIME OF DAY	39	39	39	39	39	39	39	39	39
42	ACADEMIC GRADES-ADVANCED	76	76	76	76	76	76	76	76	76
43	FLIGHT GRADES-ADVANCED	76	76	76	76	76	76	76	76	76

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table XI

Matrix indicating the number of data-pairs used in the calculation of the Table X Spearman rank correlation c

RESPONSE VARIABLE

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
86																		
86	86																	
86	86	86																
86	86	86	86															
86	86	86	86	86														
86	86	86	86	86	86													
86	86	86	86	86	86	86												
86	86	86	86	86	86	86	86											
86	86	86	86	86	86	86	86	86										
86	86	86	86	86	86	86	86	86	86									
86	86	86	86	86	86	86	86	86	86	86								
86	86	86	86	86	86	86	86	86	86	86	86							
86	86	86	86	86	86	86	86	86	86	86	86	86						
86	86	86	86	86	86	86	86	86	86	86	86	86	86					
86	86	86	86	86	86	86	86	86	86	86	86	86	86	92				
86	86	86	86	86	86	86	86	86	86	86	86	86	86	92	92			
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45		
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
38	38	38	38	38	38	38	38	38	38	38	38	38	38	44	44	44	44	44
38	38	38	38	38	38	38	38	38	38	38	38	38	38	44	44	44	44	44
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
38	38	38	38	38	38	38	38	38	38	38	38	38	38	44	44	44	44	44
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	39	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	[illegible]	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	39	[illegible]	39	39	39	39	39	39	45	45	45	45	45
39	39	39	39	39	39	[illegible]	39	39	39	39	39	39	39	45	45	45	45	45
76	76	76	76	76	76	76	76	76	76	76	76	76	76	78	78	37	37	37
76	76	76	76	76	76	76	76	76	76	76	76	76	76	78	78	37	37	37

NSE INDEX
E INDEX

elation coefficients.

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
43																		
44	44																	
44	44	44																
45	44	44	45															
45	44	44	45	45														
45	44	44	45	45	45													
44	43	43	44	44	44	44												
45	44	44	45	45	45	44	45											
45	44	44	45	45	45	44	45	45										
45	44	44	45	45	45	44	45	45	45									
45	44	44	45	45	45	44	45	45	45	45								
45	44	44	45	45	45	44	45	45	45	45	45							
45	44	44	45	45	45	44	45	45	45	45	45	45						
45	44	44	45	45	45	44	45	45	45	45	45	45	45					
45	44	44	45	45	45	44	45	45	45	45	45	45	45	45				
45	44	44	45	45	45	44	45	45	45	45	45	45	45	45	45			
37	36	36	37	37	37	36	37	37	37	37	37	37	37	37	37	78		
37	36	36	37	37	37	36	37	37	37	37	37	37	37	37	37	78	78	

Table XII

Wilcoxon matched-pairs signed-ranks comparison of the flight indices received by the study population during basic training in Squadron VT10 and advanced training in Squadron VT86-AJN. For each flight index, listings are made of the T and Z statistics associated with the Wilcoxon test, the number of students for which there was a difference between the basic and advanced index scores; and the mean, standard deviation, standard error of the mean, and number of observations for both basic and advanced training.

RESPONSE VARIABLE		WILCOXON TEST			BASIC TRAINING				ADVANCED TRAINING			
NO.	DESCRIPTION	T	Z	N	MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	-343.	-5.63*	74	25.0	19.7	2.1	86	13.6	13.3	1.4	86
2	S-VOMITING INDEX-UW	-117.	-4.83*	48	11.7	16.5	1.8	86	4.8	8.6	.9	86
3	S-P.DEGRADATION INDEX-UW	-80.5	-6.42*	64	15.4	14.0	1.6	86	5.7	9.0	1.0	86
4	S-NERVOUSNESS INDEX-UW	-680.	-4.61*	81	44.9	27.8	3.0	86	31.5	29.7	3.2	86
5	S-MEDICATION INDEX-UW	68.5	-1.36	20	1.4	4.2	.5	86	2.5	6.3	.7	86
6	S-AIRSICKNESS INDEX-W	-220.	-6.36*	75	12.4	10.5	1.1	86	6.0	6.2	.7	86
7	S-VOMITING INDEX-W	-111.	-4.89*	48	6.5	8.8	.9	86	2.6	4.7	.5	86
8	S-P.DEGRADATION INDEX-W	-85.0	-6.39*	64	7.7	8.6	.9	86	2.4	4.3	.5	86
9	S-NERVOUSNESS INDEX-W	-580.	-5.28*	83	18.8	13.2	1.4	86	11.0	11.6	1.3	86
10	S-MEDICATION INDEX-W	68.5	-1.36	20	1.4	4.2	.5	86	2.5	6.3	.7	86
11	I-AIRSICKNESS INDEX-UW	-220.	-5.60*	66	15.3	15.1	1.6	86	6.9	9.5	1.0	86
12	I-VOMITING INDEX-UW	-123.	-4.86*	49	10.6	14.2	1.5	86	4.5	8.7	.9	86
13	I-P.DEGRADATION INDEX-UW	-76.0	-5.89*	56	11.8	12.3	1.3	86	3.7	6.7	.7	86
14	I-NERVOUSNESS INDEX-UW	-455.	-5.93*	84	25.2	15.4	1.7	86	12.9	11.6	1.3	86
15	I-TURBULENCE INDEX-UW	1321.	-1.91	83	23.4	12.8	1.4	86	27.3	13.2	1.4	86
16	I-AIRSICKNESS INDEX-W	-224.	-5.63*	66	7.2	7.8	.8	86	3.1	4.8	.5	86
17	I-VOMITING INDEX-W	-103.	-5.06*	49	6.1	8.6	.9	86	2.2	4.4	.5	86
18	I-P.DEGRADATION INDEX-W	-66.0	-5.97*	56	4.8	6.0	.6	86	1.6	3.4	.4	86
19	I-NERVOUSNESS INDEX-W	-446.	-5.97*	84	9.3	5.9	.6	86	4.7	4.5	.5	86
20	I-TURBULENCE INDEX-W	1758.	-.12	84	12.4	6.9	.7	86	12.3	6.4	.7	86

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
0 = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

As indicated by the large number of significance symbols in Table XII, there were considerable differences between basic and advanced training relative to the majority of the flight indices. The trend of the differences follows that reported (4) for the VT86-AJN students who flew the old flight syllabus, in that the mean values for the airsickness-related measures were greater during basic training. This could reflect either singly or in combination a progressive adaptation of the group to motion stress as they advance through the NFO Training Program, or the exposure of the group to a less stressful flight syllabus in Squadron VT86-AJN. In the case of the previously reported (5) student population who received advanced training in Squadron VT86-RIO, the same Wilcoxon test indicated that airsickness based upon student judgments was greater during advanced training.

A further comparison of differences between student performance during basic and advanced training is provided by Table XIII which presents the results of a Spearman rank correlation analysis corrected for tied observations applied across the basic and advanced training flight indices. The rank correlation coefficients comprise the upper half of this table, and the number of data-pairs involved in each calculation is listed in the bottom portion of the table.

An examination of the principal diagonal of Table XIII shows that statistically significant correlations between basic and advanced training were present for all of the student-based flight indices with the exception of the medication usage variable. The correlation coefficients for all of the weighted and unweighted airsickness-related indices were in the moderate range, showing a substantial relationship significant to the .001 level or better between student airsickness experiences in the two squadrons. These correlation data, like those previously reported (4,5), support the contention that a good proportion of the students who experience airsickness difficulties during basic training will experience the same during advanced training. Variables 21 and 22 in Table XIII also reflect significant correlations between the academic and flight grades received in the two squadrons.

The Table XIII matrix, by definition, also describes the interrelationship that exists between a given advanced training flight index and each of the flight indices received during basic training. Again, most of these interindex correlations involve the three primary airsickness measures. In general, the correlations that exist along the principal diagonal are greater than those that exist to either side in the matrix. These observations for the students who flew the new Squadron VT86-AJN flight syllabus are in essential agreement with those noted for the students who flew the old Squadron VT86-AJN flight syllabus (4), as well as those reported (5) for the Squadron VT86-RIO population.

COMPARISON OF STUDENT PERFORMANCE: OLD VERSUS NEW VT86-AJN FLIGHT SYLLABUS

The second report (4) of the longitudinal study dealt with a population of VT86-AJN students who received flight training in a 14-hop syllabus

Table XIII

Correlation matrix for the flight indices received by the study population during basic training in Squadron VT10 and advanced training in Squadron VT86-AJN based upon the Spearman rank correlation coefficient adjusted for tied ranks. Correlation coefficients at top and number of data-pairs at bottom.

ADVANCED SQUADRON RESPONSE VARIABLE NO.	DESCRIPTION	BASIC SQUADRON RESPONSE VARIABLE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	S-AIRSICKNESS INDEX-UW	.61*	.52*	.54*	.24	.32@	.61*	.53*	.57*	.27@	.32@	.61*	.55*	.55*	.22	.39*	.60*	.55*	.54*	.22	.44*	.20	.26
2	S-VOMITING INDEX-UW	.52*	.64*	.44*	.29@	.29@	.58*	.61*	.43*	.27@	.29@	.59*	.62*	.52*	.29@	.30@	.57*	.58*	.49*	.20@	.28@	.14	.19
3	S-P.DEGRADATION INDEX-UW	.53*	.60*	.65*	.38*	.33@	.59*	.62*	.60*	.43*	.33@	.58*	.63*	.58*	.38*	.32*	.59*	.63*	.56*	.[illegible]	.45*	.03	.12
4	S-NERVOUSNESS INDEX-UW	.24	.26	.33@	.66*	.15	.29@	.29@	.37*	.65*	.15	.31@	.20@	.34@	.48*	.21	.31@	.29@	.33@	.42*	.25	-.01	-.23
5	S-MEDICATION INDEX-UW	.34@	.48*	.39*	.23	.25	.48*	.49*	.42*	.24	.25	.39*	.45*	.39*	.37*	.07	.42*	.45*	.37*	.30*	.02	-.15	-.01
6	S-AIRSICKNESS INDEX-W	.66*	.57*	.59*	.27@	.34@	.65*	.58*	.68*	.31@	.34@	.65*	.68*	.56*	.23	.41*	.63*	.58*	.56*	.23	.44*	.17	.23
7	S-VOMITING INDEX-W	.54*	.68*	.45*	.31@	.34@	.53*	.65*	.44*	.29@	.34@	.61*	.65*	.55*	.30@	.32@	.59*	.61*	.52*	.29@	.29@	.14	.18
8	S-P.DEGRADATION INDEX-W	.53*	.60*	.65*	.38*	.32@	.59*	.62*	.60*	.43*	.32@	.58*	.63*	.58*	.37*	.37*	.59*	.63*	.58*	.40*	.44*	.03	.12
9	S-NERVOUSNESS INDEX-W	.24	.26	.33@	.65*	.15	.38@	.29@	.38*	.65*	.15	.31@	.20@	.34@	.39*	.23	.31@	.29@	.33@	.41*	.27@	-.03	-.23
10	S-MEDICATION INDEX-W	.34@	.48*	.39*	.23	.25	.48*	.49*	.42*	.24	.25	.39*	.45*	.39*	.37*	.07	.42*	.46*	.37*	.30*	.02	-.15	-.01
11	I-AIRSICKNESS INDEX-UW	.45*	.49*	.37*	.00	.33@	.44*	.50*	.30*	.00	.33@	.56*	.53*	.56*	.20@	.20@	.54*	.52*	.48*	.29@	.33@	.10	.12
12	I-VOMITING INDEX-UW	.40*	.57*	.37*	.16	.33@	.49*	.54*	.37*	.14	.33@	.55*	.58*	.50*	.20	.29@	.54*	.56*	.49*	.21	.30@	.10	.20
13	I-P.DEGRADATION INDEX-UW	.40*	.56*	.39*	.04	.46*	.48*	.54*	.40*	.06	.46*	.56*	.61*	.53*	.21	.41*	.54*	.59*	.52*	.21	.44*	.17	.19
14	I-NERVOUSNESS INDEX-UW	.04	.23	.13	.17	.13	.09	.24	.13	.16	.13	.19	.23	.22	.30@	.24	.20	.22	.20@	.32	.23	.06	-.09
15	I-TURBULENCE INDEX-UW	.06	.17	.19	.15	.11	.11	.20	.24	.14	.11	.25	.24	.21	.16	.19	.25	.23	.21	.16	.21	.14	.17
16	I-AIRSICKNESS INDEX-W	.46*	.51*	.38*	.10	.33@	.45*	.51*	.40*	.10	.33@	.57*	.54*	.51*	.20	.27@	.55*	.53*	.48*	.30@	.31@	.09	.12
17	I-VOMITING INDEX-W	.42*	.57*	.38*	.16	.36*	.41*	.55*	.9*	.14	.36*	.56*	.59*	.53*	.20	.31@	.55*	.56*	.52*	.21	.32@	.20	.19
18	I-P.DEGRADATION INDEX-W	.41*	.57*	.40*	.05	.46*	.41*	.55*	.41*	.07	.46*	.56*	.61*	.54*	.22	.41*	.55*	.59*	.53*	.22	.44*	.17	.19
19	I-NERVOUSNESS INDEX-W	.02	.19	.10	.15	.11	.07	.20	.11	.16	.11	.16	.19	.18	.26	.24	.17	.18	.17	.20@	.23	.06	-.09
20	I-TURBULENCE INDEX-W	-.04	.17	.15	.04	.13	.02	.19	.20	.03	.13	.22	.25	.19	.15	.16	.21	.23	.18	.15	.22	.16	.21
21	ACADEMIC GRADES	.03	-.11	.10	-.19	-.01	-.00	-.13	.09	-.19	-.01	.02	-.00	.05	-.20	.07	.03	-.09	.00	-.19	.04	.48*	.25
22	FLIGHT GRADES	.13	.03	.06	-.16	.01	-.05	-.02	.01	-.18	.01	.00	.03	-.01	-.29@	.04	.07	-.00	.01	-.27	.11	.53*	.54*

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

ADVANCED SQUADRON RESPONSE VARIABLE NO.	DESCRIPTION	BASIC SQUADRON RESPONSE VARIABLE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	S-AIRSICKNESS INDEX-UW	86	86	86	86	86	86	86	86	86	86	86	86	66	86	86	86	86	86	86	85	86	86
2	S-VOMITING INDEX-UW	86	86	85	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	85	86	86
3	S-P.DEGRADATION INDEX-UW	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
4	S-NERVOUSNESS INDEX-UW	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
5	S-MEDICATION INDEX-UW	86	86	86	86	86	86	86	86	86	86	86	86	86	86	85	86	86	86	86	86	86	86
6	S-AIRSICKNESS INDEX-W	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
7	S-VOMITING INDEX-W	86	86	85	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	85	86	86
8	S-P.DEGRADATION INDEX-W	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	85
9	S-NERVOUSNESS INDEX-W	86	86	85	86	86	86	86	85	86	86	86	86	86	86	86	86	86	86	86	86	86	86
10	S-MEDICATION INDEX-W	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
11	I-AIRSICKNESS INDEX-UW	86	86	85	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
12	I-VOMITING INDEX-UW	86	86	86	86	86	86	86	85	86	86	86	66	86	86	86	86	86	86	86	86	86	86
13	I-P.DEGRADATION INDEX-UW	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	85	86	86
14	I-NERVOUSNESS INDEX-UW	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
15	I-TURBULENCE INDEX-UW	86	86	85	86	86	86	86	86	86	86	86	85	86	85	86	86	86	86	86	86	86	86
16	I-AIRSICKNESS INDEX-W	86	86	85	86	86	86	86	85	85	86	86	86	86	86	86	86	86	86	86	85	86	86
17	I-VOMITING INDEX-W	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
18	I-P.DEGRADATION INDEX-W	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
19	I-NERVOUSNESS INDEX-W	86	86	85	86	86	86	86	86	86	86	86	86	86	85	86	86	86	86	86	86	86	86
20	I-TURBULENCE INDEX-W	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	85	86	86
21	ACADEMIC GRADES	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78
22	FLIGHT GRADES	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78

that differed from the 18-hop syllabus flown by the VT86-AJN students of the present study. In the interest of identifying any differences that may exist between the flight and laboratory test data produced by the two populations, the Kruskal-Wallis one-way analysis of variance test corrected for tied scores was applied to the related data. The test results, shown in Table XIV, indicate that significant differences between the two populations existed for only the student-based airsickness index and the instructor-based nervousness index. For the airsickness measure, the mean was greater in the new VT86-AJN flight syllabus. The opposite was true for the nervousness measure.

This slightly higher incidence and severity of airsickness experienced under the new syllabus flight conditions could be attributed to several factors. The most obvious would be the change in the flight syllabus proper, with the new syllabus being longer and possibly incorporating a more provocative series of motion-stress hops. However, another factor that could contribute to the observed differences in the flight indices for the two squadrons would involve differences between the two student populations relative to individual susceptibility to airsickness. This factor would be reflected by differences between the laboratory test scores (variables 23-41) listed in Table XIV. As indicated in this table, statistically significant differences were observed for only one test score (variable 28), and that was the time of day that the BVDT was conducted. (As reported in the first report [3] of the series, this variable was included to evaluate the potential existence of diurnal effects on the BVDT data.) In effect, the test scores do not reflect any differences in motion sensitivity between the two populations. Thus, it is more probable that the airsickness differences shown in Table XIV are more closely allied with the change in syllabus proper rather than differences in the motion sensitivity of the two populations.

Table XIV

Results of a Kruskal-Wallis one-way analysis of variance comparison of the flight and laboratory data collected from the VT86-AJN student population who flew the old flight syllabus with the same form of data collected from the VT86-AJN population who flew the new syllabus associated with the present study.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	VT86-AJN OLD SYLLABUS MEAN	S.DEV.	S.ERR.	N	VT86-AJN NEW SYLLABUS MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	9.66@	9.4	14.7	1.3	129	13.6	13.3	1.4	86
2	S-VOMITING INDEX-UW	1.35	4.0	7.7	.7	129	4.0	8.6	.9	86
3	S-P.DEGRADATION INDEX-UW	4.03	3.6	8.3	.7	129	5.7	9.0	1.0	86
4	S-NERVOUSNESS INDEX-UW	.49	34.5	30.9	2.7	129	31.5	29.7	3.2	86
5	S-MEDICATION INDEX-UW	5.45	1.1	4.2	.4	129	2.5	6.3	.7	86
6	S-AIRSICKNESS INDEX-W	9.86@	4.0	6.6	.6	129	6.0	6.2	.7	86
7	S-VOMITING INDEX-W	1.98	1.0	3.6	.3	129	2.6	4.7	.5	86
8	S-P.DEGRADATION INDEX-W	3.01	1.5	3.6	.3	129	2.4	4.3	.5	86
9	S-NERVOUSNESS INDEX-W	.07	13.5	12.9	1.1	129	11.0	11.6	1.3	86
10	S-MEDICATION INDEX-W	5.45	1.1	4.2	.4	129	2.5	6.3	.7	86
11	I-AIRSICKNESS INDEX-UW	3.59	5.0	8.8	.0	120	6.9	9.5	1.0	86
12	I-VOMITING INDEX-UW	1.44	3.5	7.0	.6	120	4.5	8.7	.9	86
13	I-P.DEGRADATION INDEX-UW	2.42	2.6	6.5	.6	120	3.7	6.7	.7	86
14	I-NERVOUSNESS INDEX-UW	29.55*	24.7	17.3	1.5	120	12.9	11.6	1.3	86
15	I-TURBULENCE INDEX-UW	1.28	30.7	16.0	1.5	120	27.3	13.2	1.4	86
16	I-AIRSICKNESS INDEX-W	2.60	2.3	4.5	.4	120	3.1	4.0	.5	86
17	I-VOMITING INDEX-W	1.53	1.6	3.3	.3	120	2.2	4.4	.5	86
18	I-P.DEGRADATION INDEX-W	2.05	1.1	3.0	.3	120	1.6	3.4	.4	86
19	I-NERVOUSNESS INDEX-W	31.16*	10.0	8.1	.7	120	4.7	4.5	.5	86
20	I-TURBULENCE INDEX-W	.03	13.0	7.7	.7	120	12.3	6.4	.7	86
23	TMSQ1-MS HISTORY,PART 1	.00	8.6	11.1	1.0	122	7.2	8.6	1.3	45
24	TMSQ2-MS HISTORY,PART 2	.71	6.5	9.6	.9	122	4.9	7.2	1.1	45
25	TMSQ3-MS HISTORY,SUM	.15	15.1	18.2	1.6	122	12.1	12.5	1.9	45
26	TSANX-STATE/ANX.QUEST.	.29	33.2	11.3	2.7	18	30.6	8.2	1.2	44
27	TTANX-TRAIT/ANX.QUEST.	.49	28.1	5.4	1.3	18	29.3	6.6	1.0	44
28	TBVDT-BVDT TIME OF DAY	13.59*	9.9	1.0	.2	120	8.9	.9	.1	45
29	TBVDR-BVDT RATER	1.37	13.0	6.4	.6	123	14.9	6.6	1.0	45
30	TBVDS-BVDT SELF-RATING	.06	15.0	6.9	.6	123	13.9	6.0	1.0	45
31	TBVDP-BVDT POST-RATING	.60	6.0	13.6	1.3	110	4.4	10.3	1.6	44
32	TVVSP1-VVIT STATIC-RIGHT	1.77	121.0	7.2	1.4	25	121.5	10.1	1.5	45
33	TVVSP2-VVIT STATIC-WRONG	1.31	6.0	6.0	1.2	25	5.1	6.9	1.0	45
34	TVVSP3-VVIT STATIC-OMIT	.21	2.0	2.6	.5	25	2.4	4.0	.7	45
35	TVVDP1-VVIT DYNAMIC-RIGHT	1.07	65.6	29.7	5.9	25	76.0	35.9	5.4	45
36	TVVDP2-VVIT DYNAMIC-WRONG	.06	10.0	5.0	1.2	25	9.0	0.2	1.2	45
37	TVVDP3-VVIT DYNAMIC-OMIT	1.00	52.6	30.6	6.1	25	43.1	36.0	5.5	45
38	TVVIR-VVIT RATER	.39	16.3	7.5	1.5	25	15.1	6.5	1.0	45
39	TVVIS-VVIT SELF-RATING	3.01	17.6	7.6	1.5	25	13.6	5.7	.0	45
40	TVVIP-VVIT POST-RATING	3.10	0.3	11.6	2.3	25	4.9	9.4	1.4	45
41	TVVIT-VVIT TIME OF DAY	.27	10.7	2.2	.4	25	10.1	1.3	.2	45

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

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APPENDIX A

Brief Description of Individual Hops Comprising the New Flight Syllabus of Advanced Training Squadron VT86-AJN

VT86-AJN (New Syllabus)

LL-1, -2, -3	Low Level Navigation
RN-1, -2, -3, -4, -5	Radar Navigation
RA-1, -2, -3	Radar Analysis
AN-1	Airways Navigation
D-1, -2	TA-4J Familiarization
ATM-1, -2, -3, -4	Advanced Tactical Maneuvers

All hops flown in T-39D with the exception of D-1, -2, ATM-1, -2, -3, -4, which were in the TA-4J.

APPENDIX B

Brief Description of Laboratory Tests Comprising the 1977-1978 Prototype Motion Sickness Sensitivity Test Battery

Variable No.	Symbol Code	Test Description
23 24 25	TMSQ1 TMSQ2 TMSQ3	Two-part motion sickness history form describing motion sickness incidence and exposure level. TMSQ1 summarizes the history before the age of 12 and has a minimum value of 0.0 denoting no problems and a maximum value of 180 denoting high susceptibility. TMSQ2 pertains to motion sickness experience following age 12 with the same minimum and maximum values. TMSQ3 is the numerical sum of the TMSQ1 and TMSQ2 scores. For details, see Reason, J. T., An investigation of some factors contributing to individual variation in motion sickness susceptibility. FPRC Committee Report 1277. London: Ministry of Defence, 1968.
26 27	TSANX TTANX	This State-Trait Anxiety Inventory is comprised of two self-report scales. The State Anxiety scale (TSANX) reqires the individual to report how he feels at that particular moment in time, while the Trait Anxiety Scale (TTANX) requires the individual to report how he generally feels. Both scales have a minimum score of 20, denoting minimum anxiety and a maximum score of 80 denoting maximum anxiety. For details, see Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E , STAI Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press, 1970.
28 29 30 31	TBVDT TBVDR TBVDS TBVDP	Brief Vestibular Disorientation Test (BVDT) involving cross-coupled angular acceleration stimuli produced by paced head motions on a rotating chair. TBVDT denotes the time of day the test was given based upon a 24-hour decimal clock. TBVDR is the test score given by the rating panel and has a minimum value of 6 denoting no motion symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the BVDT, each subject rated his own reactions to the test coded as TBVDS with a minimum score of 7 indicating no reaction and a maximum score of 49 denoting high reaction. A report of aftereffects was obtained from the subject 24 hours later and coded as TBVDP with a minimum score of 0 denoting no aftereffects and a maximum score of 180 denoting a high level of aftereffects. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

Variable No.	Symbol Code	Test Description
32	TVVSP1	These scores pertain to the task performance element of the Visual-Vestibular Interaction Test (VVIT). The tasks involve the visual scan, acquisition and identification of a complex numerical display. Under static conditions, TVVSP1 denotes the number of correct responses, TVVSP2 the number of incorrect responses, and TVVSP3 the number of omitted responses.
33	TVVSP2	
34	TVVSP3	
35	TVVDP1	The dynamic performance test scores TVVDP1, TVVDP2, and TVVDP3 describe the same response scores recorded while the subject undergoes passive sinusoidal rotation. For both the static and dynamic performance tests, the minimum scores within a given response category are 0 and 129, respectively, with the further condition that sum of the correct, incorrect, and omitted scores must total 129. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.
36	TVVDP2	
37	TVVDP3	
38	TVVIR	These scores pertain to the motion sickness symptom rating element of the Visual-Vestibular Interaction Test (VVIT). TVVIR is the test score given by the rating panel and has a minimum value of 6 denoting no motion sickness symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the VVIT, each subject rated his own reaction to the test, which was coded as TVVIS, with a minimum score of 7 denoting no reaction and a maximum score of 70 denoting high reaction. A report of aftereffects was obtained from the subject approximately 24 hours later and coded as TVVIP with a minimum score of 0 denoting no aftereffects. TVVIT denotes the time of day the test was administered based upon a 24-hour decimal clock. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.
39	TVVIS	
40	TVVIP	
41	TVVIT	

APPENDIX C

Normalized Cumulative Frequency Distribution of Flight Indices and Laboratory Test Scores for the Squadron VT86-AM Population (New Syllabus)

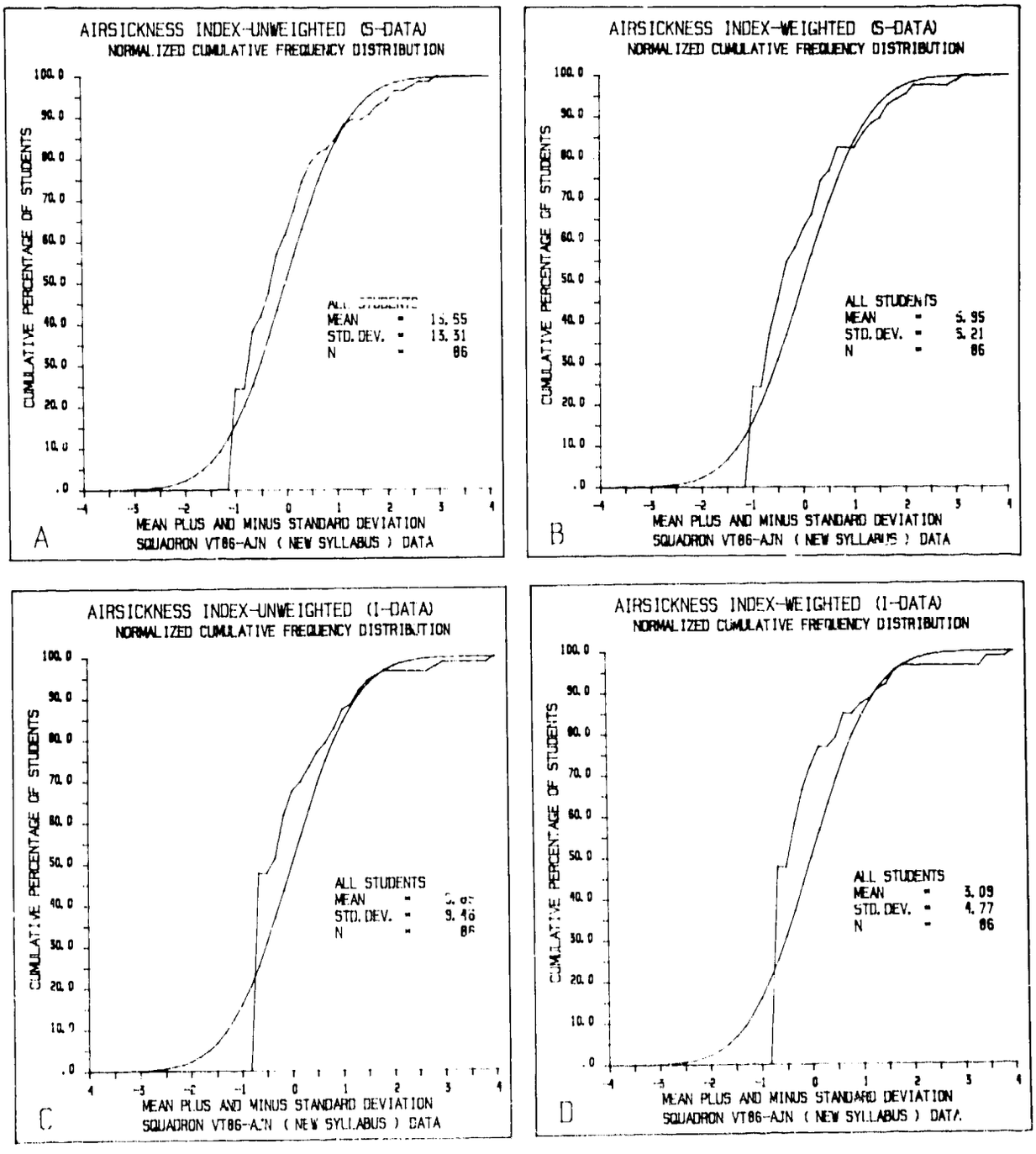


Figure C1

Normalized cumulative frequency distributions of unweighted (A) and weighted (B) airsickness indices calculated from the student questionnaire data and the equivalent unweighted (C) and weighted (D) indices calculated from the instructor data. Each plot contains the distribution of the observed data (irregular curve) and an equivalent Gaussian distribution (smooth curve) with the same mean and standard deviation as the observed data. The weighted student data (B) indicate that approximately 24 percent of the students never reported experiencing airsickness during flight training in this squadron. The same data show that a weighted airsickness index of approximately 15.9 defined the upper decile (most sensitive students) of the distribution.

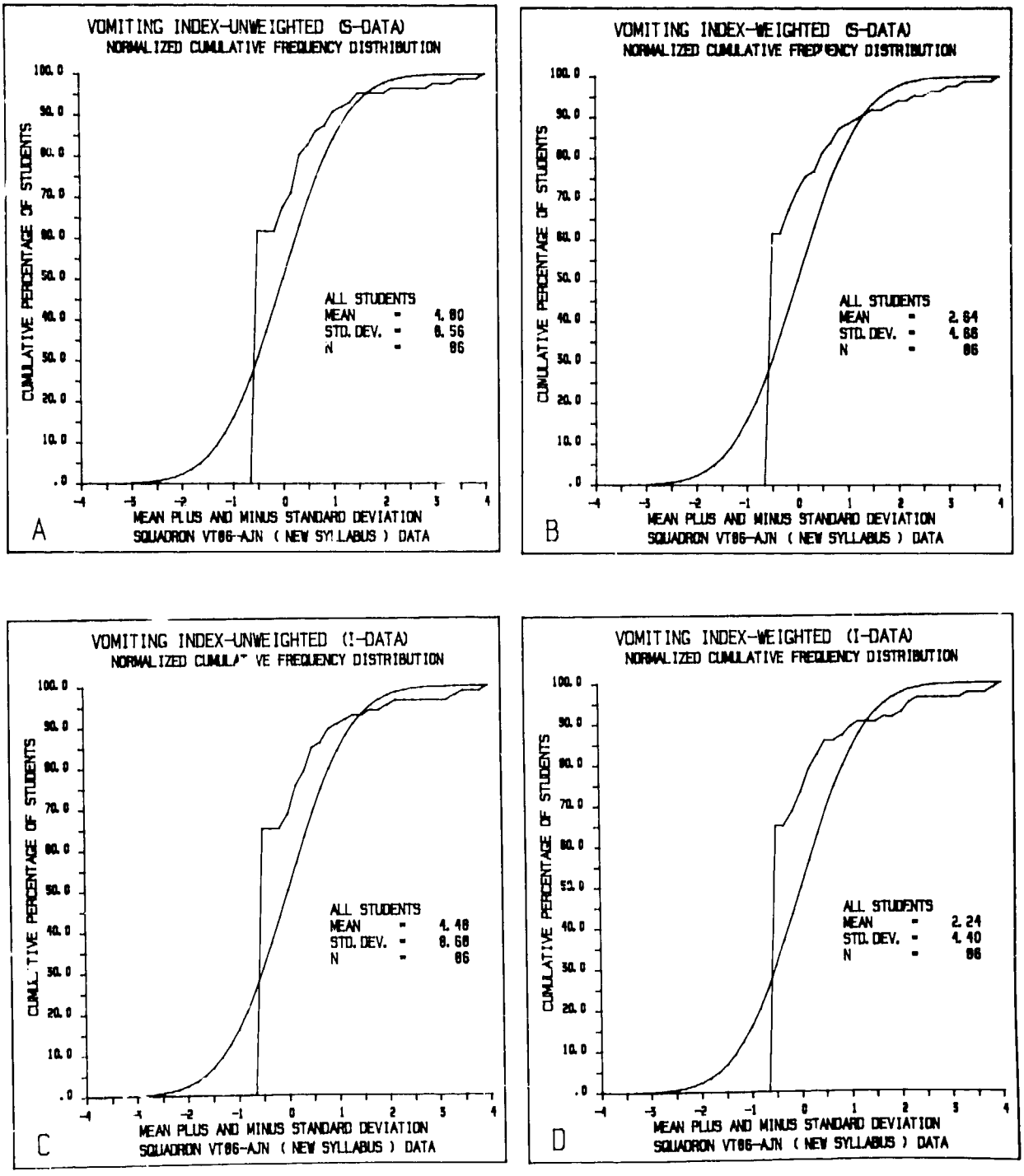


Figure C2

Normalized cumulative frequency distributions of unweighted and weighted vomit indices following the Figure C1 format. The weighted student data (B) indicate that approximately 62 percent of the students never vomited during flight training. A weighted index of approximately 8.8 defined the upper decile for this distribution.

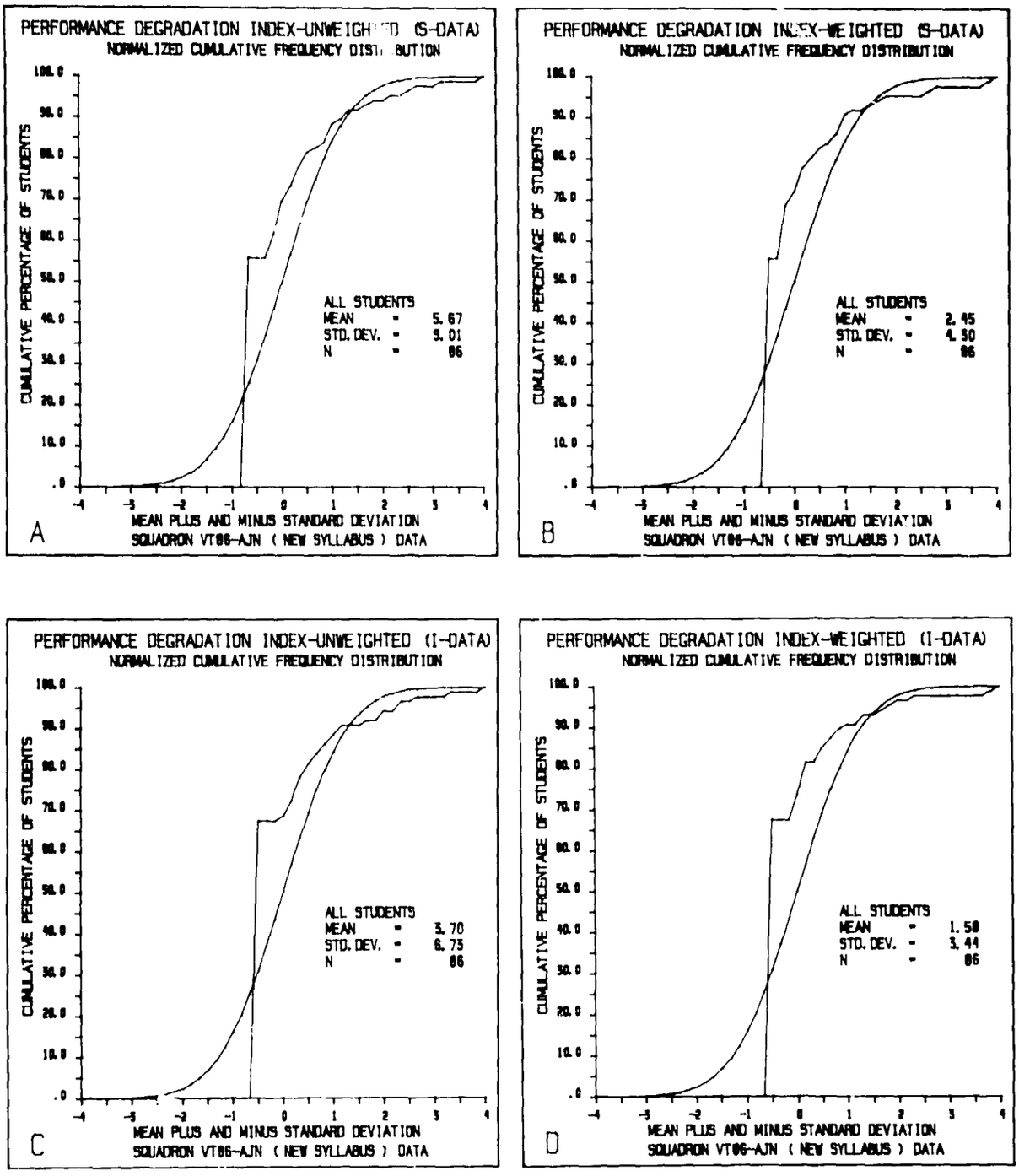


Figure C3

Normalized cumulative frequency distributions of unweighted and weighted performance degradation indices following the Figure C1 format. The weighted student data (B) indicate that approximately 56 percent of the students reported never experiencing performance degradation due to airsickness during flight training. A weighted index of approximately 7.0 defined the upper decile for this distribution.

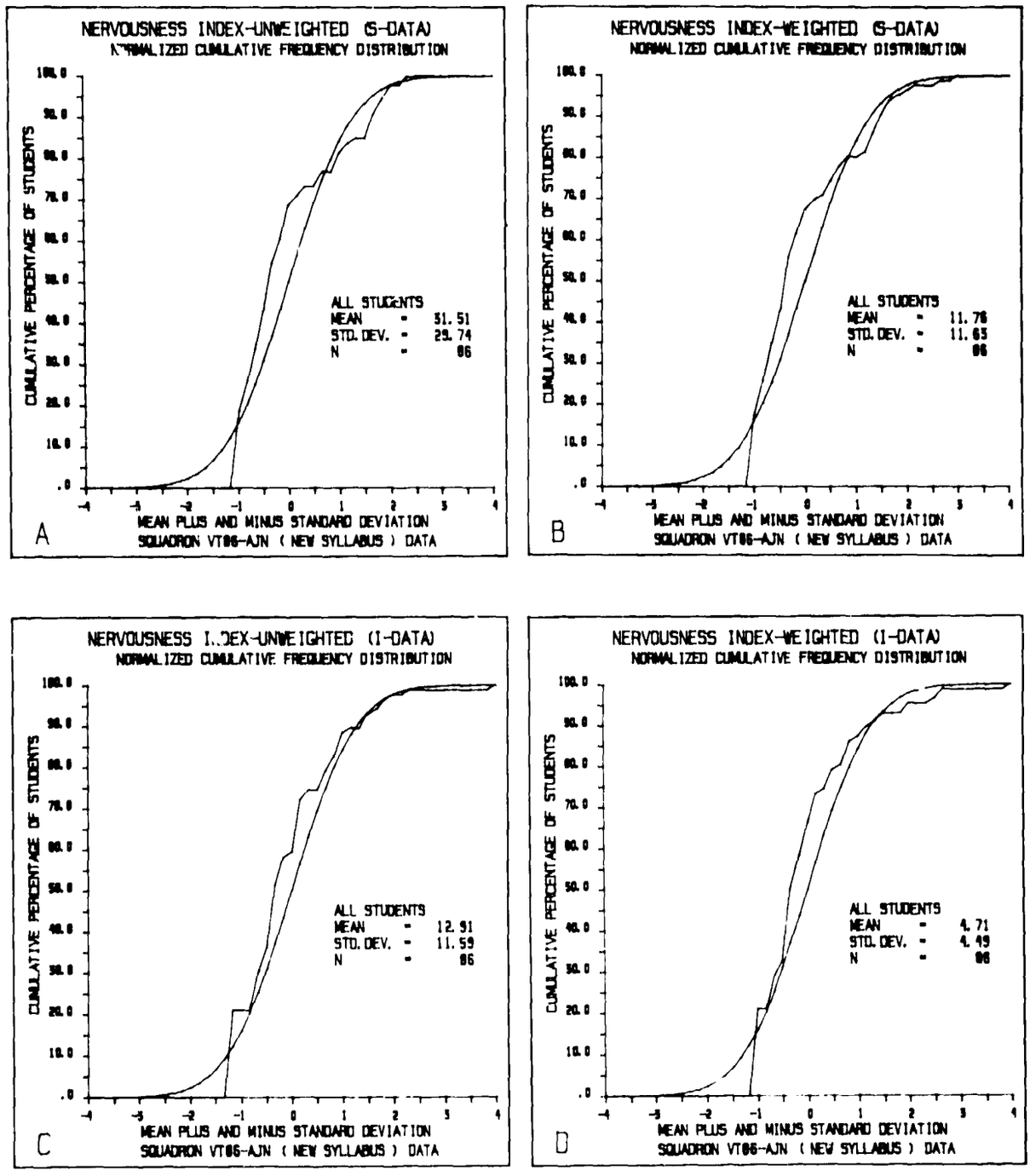
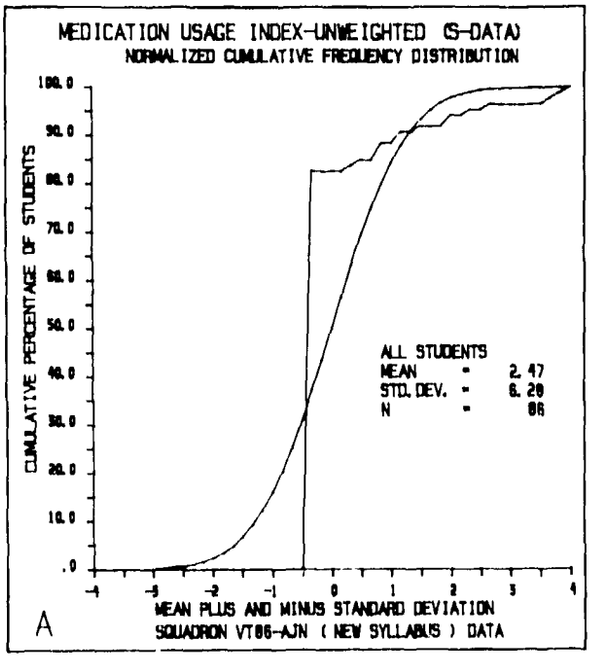
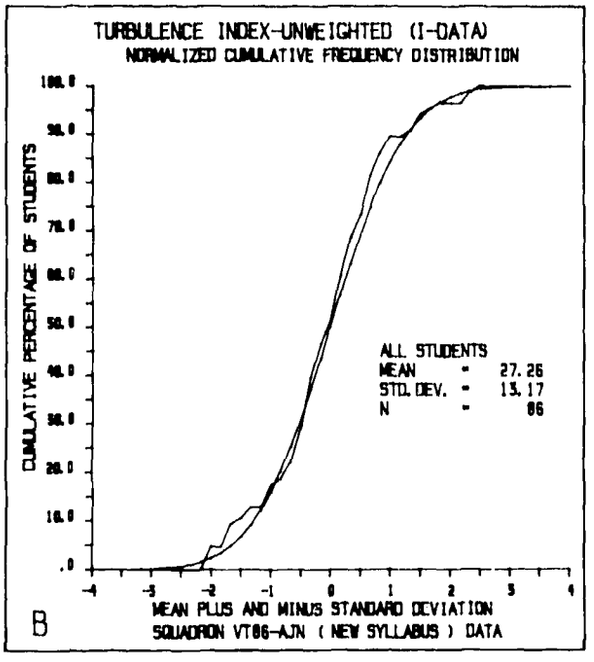


Figure C4

Normalized cumulative frequency distributions of unweighted and weighted nervousness indices following the Figure C1 format. The weighted student data (B) indicate that only 17 percent of the students reported never experiencing nervousness prior to or during a flight. A weighted index of approximately 29.9 defined the upper decile for this distribution.





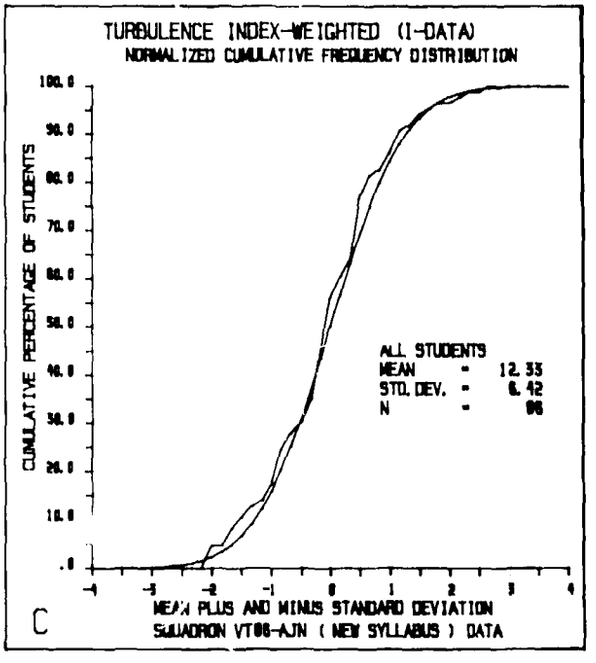
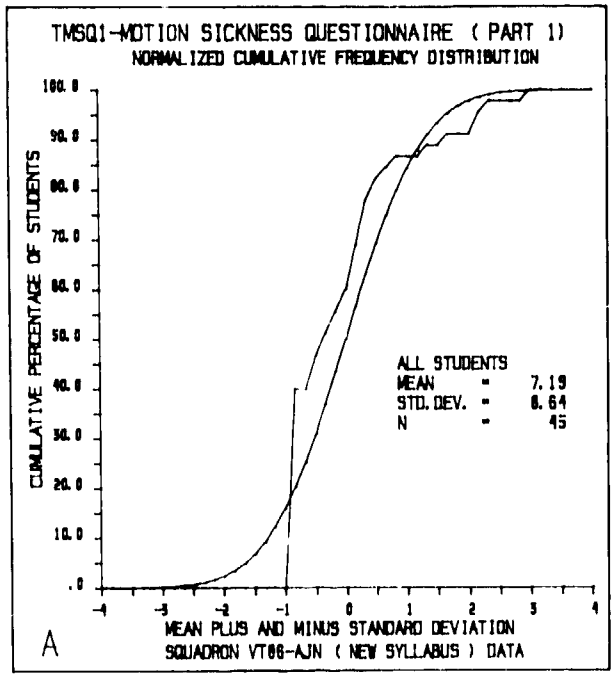
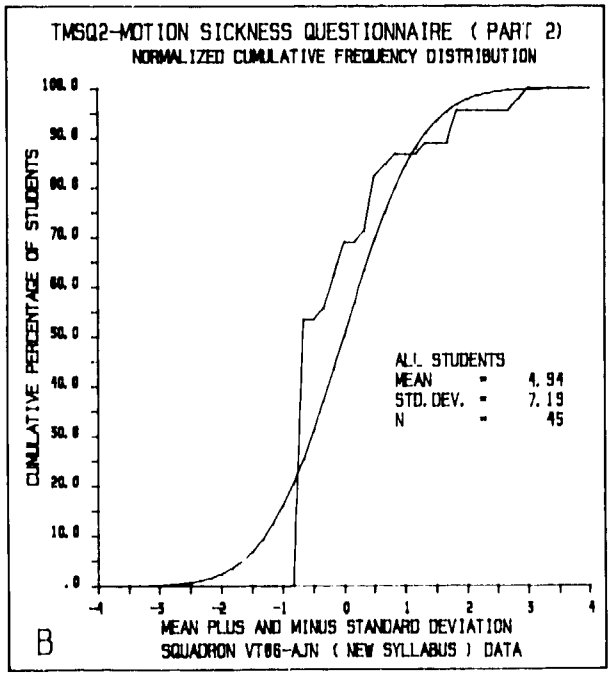


Figure C5

Normalized cumulative frequency distributions of the student-derived medication usage index (A) and the instructor-derived unweighted (B) and weighted (C) turbulence indices. The medication data again emphasize the relatively small number of students reporting the use of airsickness drugs during training. The turbulence data, as compared to the other indices, more closely approach a normal distribution.





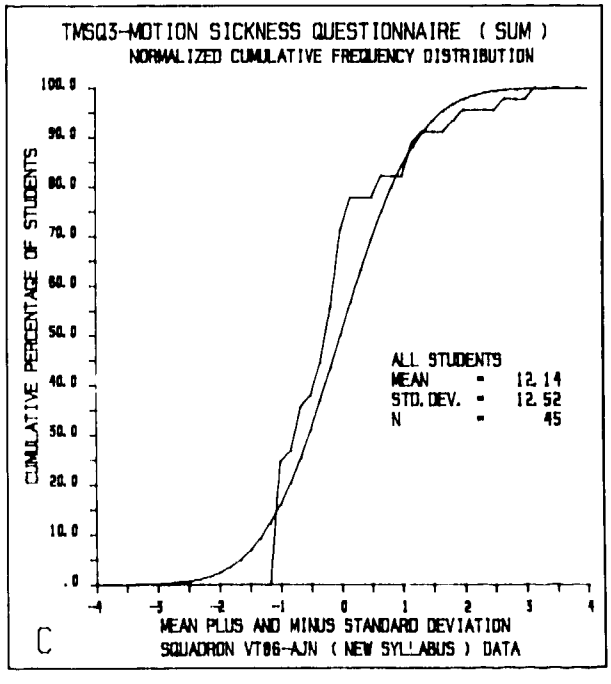


Figure C6

Normalized cumulative frequency distributions (irregular curve) of the three motion sickness history scores derived from the VT86-AJN population. Each plot also shows the equivalent distribution of a theoretical Gaussian population (smooth curve) with the same mean and standard deviation as the related laboratory test scores.

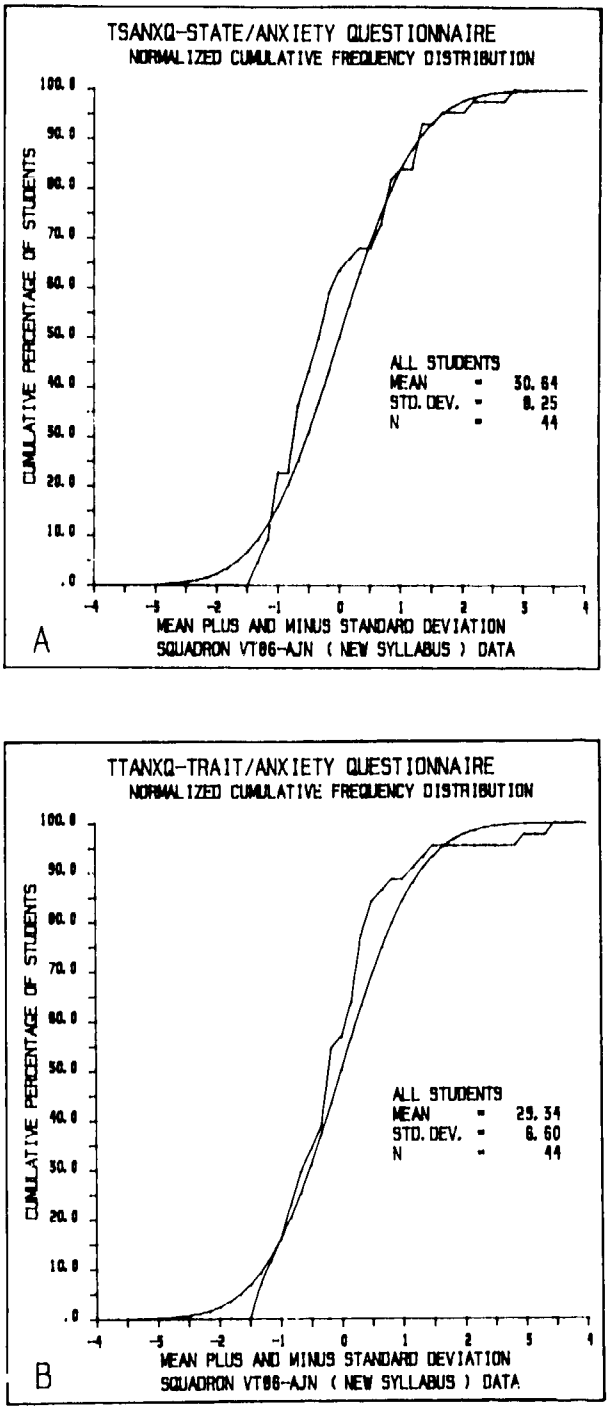


Figure C7

Normalized cumulative frequency distributions of State/Anxiety (A) and Trait/Anxiety (B) test scores based upon the observed data (irregular curves) and a theoretical Gaussian population (smooth curves) having the same mean and standard deviation as the observed test scores.

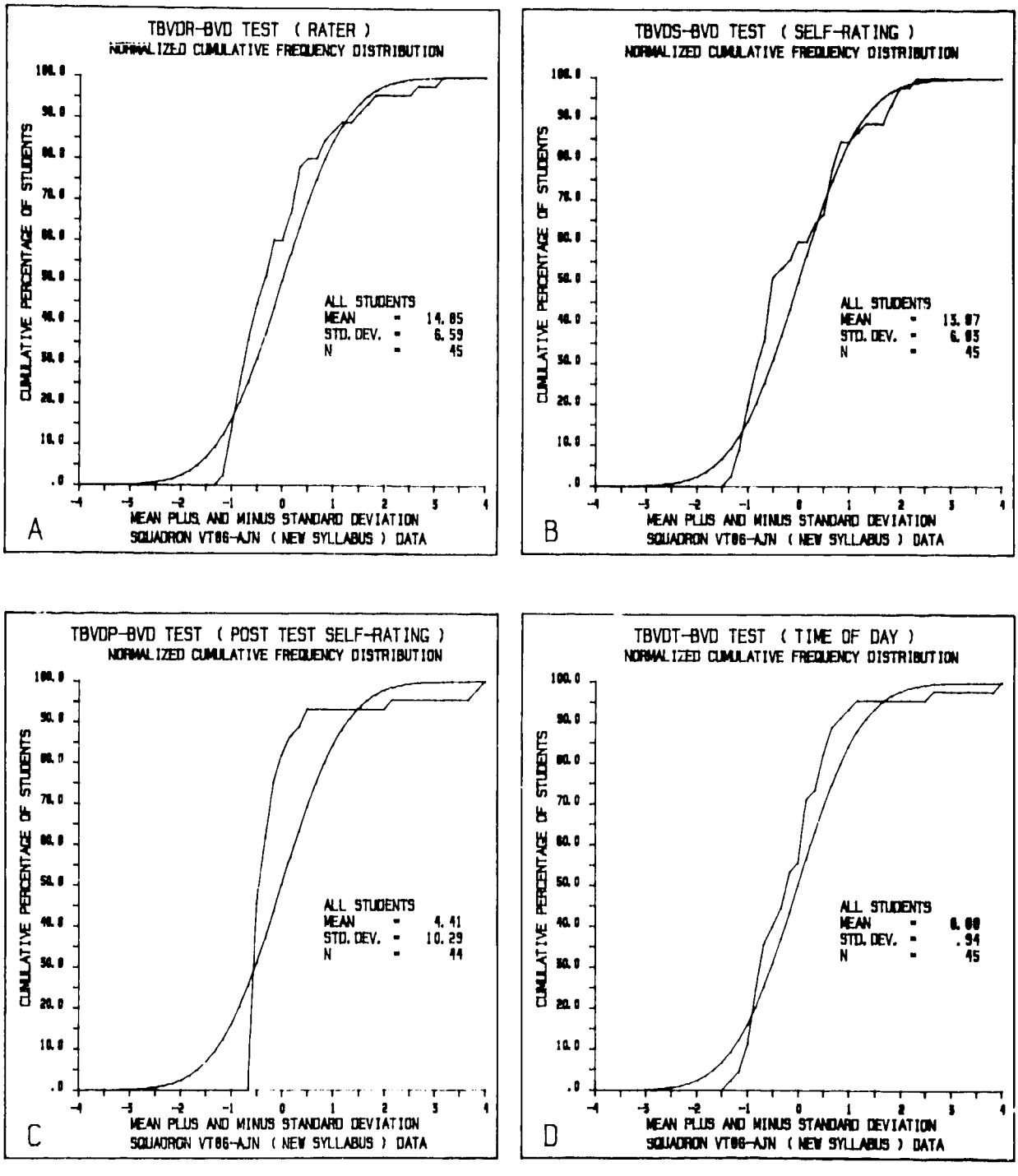
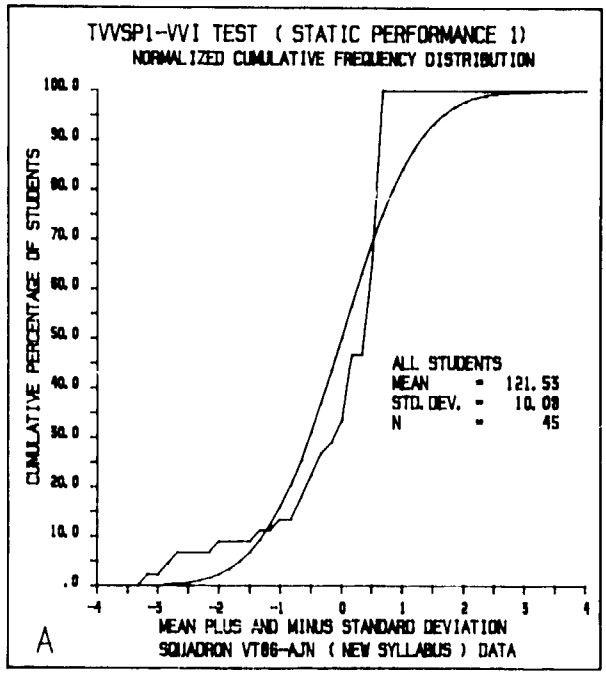
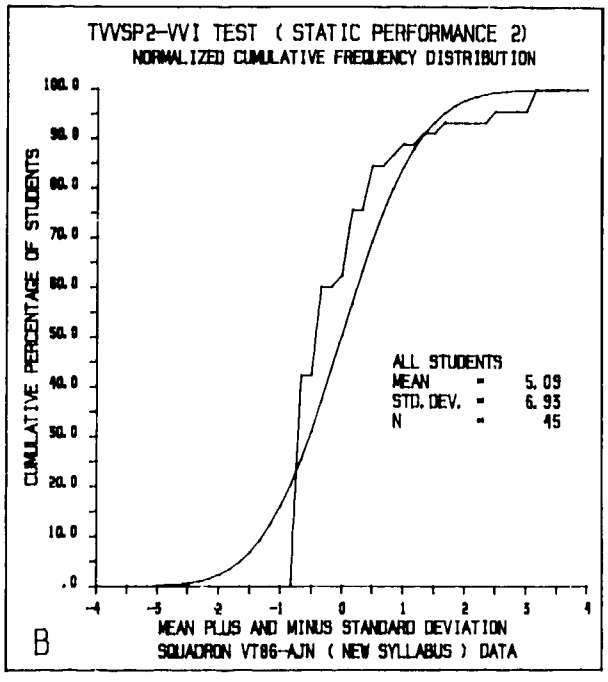


Figure C8

Normalized cumulative frequency distributions of the Brief Vestibular Disorientation Test (BVDT) scores (irregular curves) and equivalent theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.





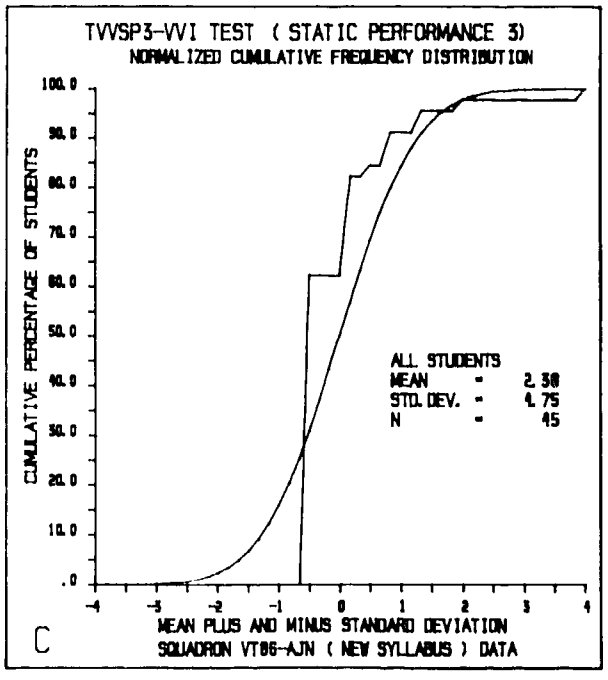
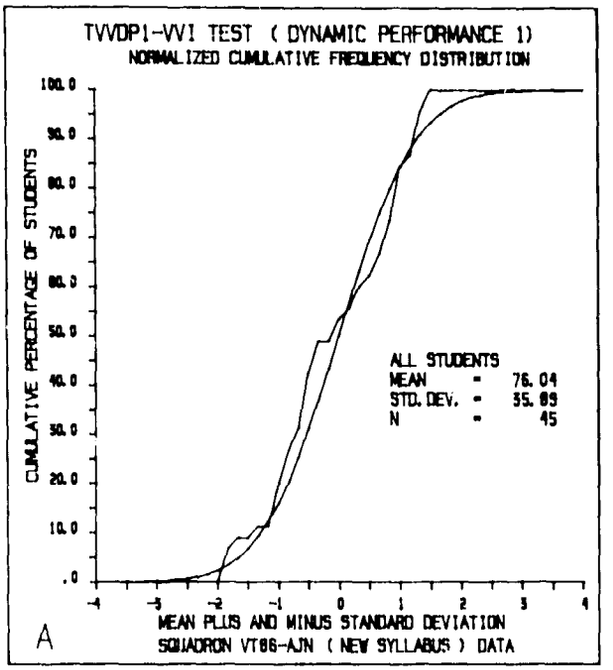
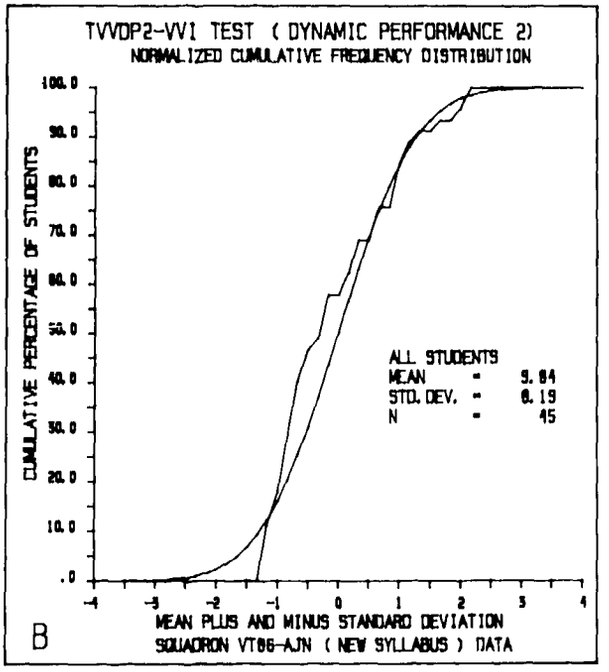


Figure C9

Normalized cumulative frequency distributions of three static performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.





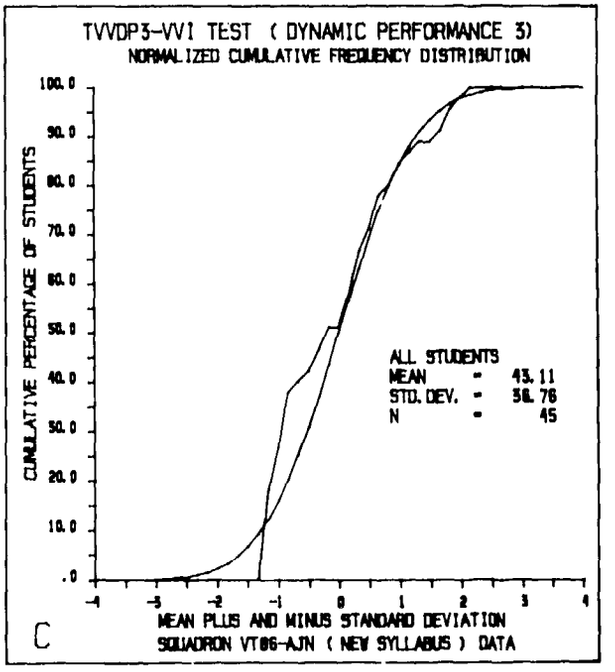


Figure C10

Normalized cumulative frequency distributions of the three dynamic performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

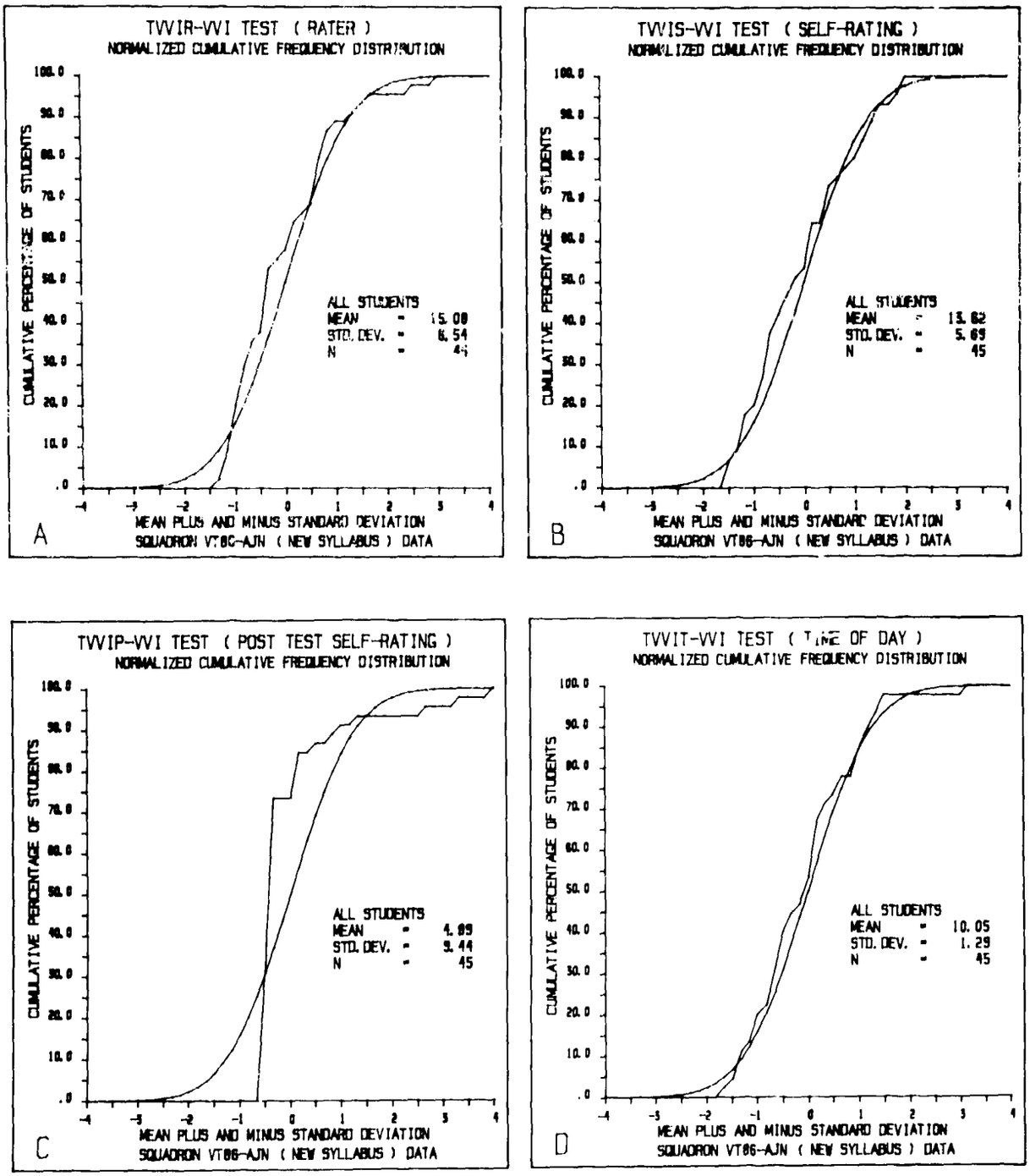


Figure C11

Normalized cumulative frequency distributions of the Visual-Vestibular Interaction Test (VVIT) scores (irregular curves) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NAMRL- 1279	2. GOVT ACCESSION NO. AD-A106 377	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Airsickness during Naval Flight Officer Training: Advanced Squadron VT86-AJN (New Syllabus)		5. TYPE OF REPORT & PERIOD COVERED Interim 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) W. Carroll Hixson, Fred E. Guedry, Jr., J. Michael Lentz, and Garry L. Holtzman, CDR, MC, USN		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Aerospace Medical Research Laboratory and Naval Aerospace Medical Institute Naval Air Station, Pensacola, Florida 32508-5700		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS MF58.524.005-7032
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Medical Research and Development Command National Naval Medical Center Bethesda, Maryland 20014		12. REPORT DATE 25 June 1981 13. NUMBER OF PAGES 57
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Mr. Hixson and Drs. Guedry and Lentz are with the Naval Aerospace Medical Research Laboratory, and Commander Holtzman is currently assigned to the USS Dwight D. Eisenhower, CVN-69, FPO New York 09501.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Naval aviation; Aviation medicine; Naval Flight Officers; Basic training; Aircrew performance; Attrition; Airsickness; Biomedical tests; Motion sickness

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is the fifth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT86-AJN students receiving secondary training under a new flight syllabus. Of the 92 students included in the study, approximately 71 percent reported being airsick on one or more flights, 36 percent reported vomiting on one or more flights, and 41 percent considered their flight

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performance to have been degraded by airsickness on one or more hops. Of the 1,552 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 13.1, 4.6, and 5.5 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Hixson, W. C. 1981
F. E. Guedry, Jr., J. M. Lentz, G. L. Holtzman

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: ADVANCED SQUADRON VT86-AJN (New Syllabus). NAMRL-1279. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 25 June.

This report is the fifth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT86-AJN students receiving advanced training under a new flight syllabus. Of the 92 students considered in this report, approximately 71 percent reported being airsick on one or more flights, 36 percent reported vomiting on one or more flights, and 41 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 1,552 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 13.1, 4.6, and 5.5 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

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